

AVIATION WEEK

A MCGRAW-HILL
PUBLICATION

October 29, 1956 50 cents

Piper Broadens
Model Line to
Meet Sales Goal



Saab 35 Drakens

Aerodynamic Heating
Taxes Test Ingenuity

Supersonic, Space
Flight Simulated

First in Constant Speed Drives...



New electrical concept in F-102A attributed to Sundstrand Constant Speed Drives

The advanced Air Force T-301A all-weather supersonic interceptor, built by Convair, incorporates the new concept in electrical systems. Here, due to the Sundstrand Constant Speed Drive is an automatic constant frequency a-c source providing plenty of stable power, with heavy overload capacity under all flight conditions. Here is reliable power for operation of electronic devices which make the T-301A a modern, rugged, all-weather weapon. And here is another example of how the new concept in electrical systems, fostered by Sundstrand's Constant Speed Drive, meets the challenges of today's... and tomorrow's... fast, high flying jet aircraft. Can we help you?

New Electrical Horizons...

are opening to design engineers, through co-operation between engine and turbine manufacturers and Sundstrand. With this new concept in electrical systems, expect remarkable advances in operation and performance of tomorrow's aircraft.

SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company, 8000 OGDEN BLVD., Western Division Office, Pasadena, California
CONSTANT SPEED DRIVES • AIRCRAFT ACCESSORIES



DOUGLAS and GOODYEAR teamwork

results in 3 important "FIRSTS" and important weight-savings for the "Seven Seas"!

- FIRST preference to place in use Tri-Metallic Brakes
- FIRST commercial transport to be delivered with tubular tires
- FIRST commercial transport to use largest magnesium wheels

In a 5,000-mile flight, each pound saved takes on added significance—and three weight-saving pieces of Goodyear equipment contribute importantly to the success of the new Douglas DC-7C range and revenue as an oceanic carrier.

First, the DC-7C specified Goodyear Tri-Metallic Brakes to take advantage of the weight and space savings that result from this new brake design, which gives up to 50% more kinetic energy absorption per pound of brake.

Second, these main wheels are equipped with Goodyear Tubular Tires—eliminating tube weight, simplifying assembly and increasing payload performance, thanks to Goodyear's exclusive S-T Nylon construction.

Third, main wheels of largest magnesium by Goodyear were selected as original equipment because of their proved capacity per pound, greater and life, absence of fatigue "hotspots"—and weight savings of 15% over conventional cast magnesium wheels.

The DC-7C typifies Goodyear's ability to engineer the complete package—tires, wheels and brakes—with outstanding results.

The confidence placed in these eight is based on this simple fact:

More airplanes based on Goodyear tires, wheels and brakes than on any other kind.

Goodyear, Aviation Products Division
 Akron 15, Ohio, and Los Angeles 54, California

FACILITIES + ABILITIES
 = EXTRA **PERFORMANCE**





Dow high temperature magnesium alloys have excellent fabrication characteristics

Lightweight structural metals with high strength, stiffness and ductility at elevated temperatures? A new group of Dow magnesium alloys offers a great combination of these properties without the fabricating difficulties normally encountered with other high temperature materials.

Specially developed for use in airframes, nacelle and engine structures, the new alloys are already making weight reductions possible for several manufacturers. These alloys show advantages at temperatures up to 700°F. Limited test data on properties up to 800°F are available for some of them.

FABRICABILITY: Fabrication characteristics are equal to those of standard magnesium alloys.

WELDABILITY: 95 to 100% weld efficiency at elevated temperatures.

FORMABILITY: Single deep draws can be easily accomplished.

MACHINABILITY: Best machining characteristics of any standard metal.

One of the new alloys is magnesium-thorium composition HK31A. It is now available in rolled form from stock. Castings and sheet as well quantities can also readily be made. A magnesium alloy for extruded shapes and forgings will soon be in production.

For more information about the new high temperature magnesium alloys, contact your nearest Dow Sales Office or write

to THE DOW CHEMICAL COMPANY, Magnesium Sales Department MA-104-1, Midland, Michigan.



EARLY FORMED: These HK31A parts were drawn using redundant dies and processes for standard magnesium alloys. The parts attained a higher percentage of original properties than standard alloys.

you can depend on **DOW MAGNESIUM**

DOW

WELDING PROGRESS REPORT

Production Line Experience Proves the Consistency of New Sciaky Electronic Weld Control

Test reports from aircraft industry manufacturers are unanimous in their recognition of the absolute weld consistency and positive reproducibility provided by the new Sciaky Preprogrammed Electronic Control controlled welders.

Users say that, for the first time, it is now possible to get precisely what they set on the welder. The machine cannot deviate from its setting. It is consistent throughout the entire range of adjustment. And set up to repeat previous production runs is simple and positive.

How It Works

Without deviation, the new Sciaky control controls the cycles of power line frequency which is governed by the U.S. Naval Observatory, in predetermined absolute numbers, cycles and impulses are simply counted by a Dekatron tube to control the duration of various welder functions.

Single Tube Handles All Sensitive Functions

A single tube is used to count both the respective cycles of various functions as well as impulses of welding current. For example, only one Dekatron tube is used to count respective cycles of argon, weld, hold and off and in respective impulses, preheat, weld and postheat. A second Dekatron tube is needed only for nonfunctioning functions, such as cool, heat, and current decay.

All control dials for timing functions are calibrated in cycles, while

all control dials for interval functions are calibrated in impulses of arc time or current. No involved second-to-cycle calculations are required for welder set-up.

Simple Maintenance

Plug-in sub-assembly control units minimize maintenance downtime. Replacement of a sub-assembly is only a matter of minutes.

The absolute consistency of the control eliminates the need for time consuming pre-weld check-out or calibration.

Future applications of the machine that may require additional welder functions won't obsolete the welder. The plug-in sub-assembly feature permits easy addition of post-heat, spool, post-heat, etc.

Data Available

More complete information on operation and control combinations available with Sciaky Preprogrammed Electronic Control controlled welders is given in Sciaky Bulletin No. 139. Copies are available on request.



FWM 2 STR 125 KVA ROLL SPOT AND BEAM WELDER with Preprogrammed Electronic Control Weld Control.

Original Manufacturers of Resistance Welding Machines in the World
Sciaky Bros., Inc., 4935 West 67th Street, Chicago 26, Ill., Portsmouth 7-5400

SCI AKY

A **Capital** IDEA:

JOY AXIVANE® FANS
AIR CONDITION
VISCOUNTS!

new airliner makes most of **THIS** space-saving design

CAPITAL AIRLINES is proud of its sparkling new turbo-prop Viscounts. The finer aeronautical and electronic know-how has been employed in the development of this inspiring new airliner.

This advanced thinking is apparent, too, in the Viscount's air conditioning system. For the heart of the system they selected a Joy AXIVANE Fan . . . and used to full advantage the inherent space-saving characteristics of this unique air-fan design.

Because Joy AXIVANE Fans can be installed *in the duct*, they may be located in any part of a plane that

has ducting. Light-alloy magnesium and aluminum construction save weight but give the greatest vibration-resisting and shock-resisting strength.

FROM 20 CFM TO OVER 6000 CFM is the range of capacity of Joy AXIVANE Aircraft Fans . . . in weights from 10 ounces to 30 pounds. Joy Axivane Aircraft Fans are working, today, in Grumman, North American, Douglas, Martin, and Sikorsky Aircraft. You can put them to work in yours, too. For details write Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

Write for FREE Bulletin 124-89

ALL JOY AXIVANE AIRCRAFT FAN MODELS ARE BUILT TO CONFORM TO ARMY AND NAVY SPECIFICATIONS WITH OVER 50 SEPARATE MODELS AVAILABLE IN A LARGE RANGE OF PERFORMANCE . . . CAPSA DESIGN AVAILABLE ON REQUEST

Consult a Joy Engineer

JOY AXIVANE

JOY

WORLD'S LARGEST MANUFACTURER
OF VANE-AXIAL FANS

1945 MN-62

1944 AN/AN-67

1941 SDF-249

1940 MN-26/MN-31

Bendix
PIONEER AND LEADER IN
ADF

DFA-70

NOW THE DFA-70—SMALLER, LIGHTER WITH GREATER ACCURACY, HIGHER SENSITIVITY

Here's another big advance in automatic direction finding from Bendix . . . the new DFA-70 system. It provides greater accuracy and higher sensitivity that make possible ± 3 degree bearing accuracy with repeat signals as low as 12.5 microvolts.

Only 14 ATK, the DFA-70 system includes excitation for simplified maintenance. Electronic tracking with digital indicator eliminates such shafts and permits the control panel to be located as far as 50 feet from antenna. Signal lines up to 35 feet can be used or up to 60 feet with digital modification. Other outstanding features include air-to-ground signal reception, ARINC Class 1 ruggedized

cabin throughout, and new circuitry that minimizes precession rate.

Bendix ADF has been the "standard of the industry" since radio direction finder equipment was first introduced. From the MN-26/MN-31 to our present DFA-70 system, Bendix has pioneered and developed most of the advancements in automatic direction finding navigation systems.

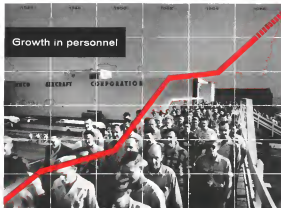
For complete information and specifications about DFA-70, write Bendix Radio, Automatic Electronic Products, Baltimore 4, Maryland. Or nearest West Coast—Bendix Radio, 10500 Miraloma Boulevard, North Hollywood, California. Export—Bendix International, 285 East 42nd Street, New York 17, New York.



DFA-70 automatic direction finder system. Left: upper ADFH; right: radio signal indicator (DS-7); control panel (DS-12). Both ADFH indicator (DS-7) and control panel.

Bendix Radio Division





**At TEMCO
growth tells
the story!**

Growth—in personnel, for example, tells the Temco success story.

In 1965, Temco had 239 employees. Today, Temco has over 10,000 employees—at three integrated Texas plants—at work on contracts covering fourteen of the country's key military aircraft. Contract expansion is every department has equipped Temco to meet the increasing needs of the aircraft industry—to push ahead the company's own developments in electronics and in aircraft and weapon systems.

Temco's steady growth—in skills, facilities and experience—opens up outstanding opportunities for a complete range of engineering talent. If you are looking for a rewarding career in aviation, you will find it at Temco.

ENGINEERS

Openings in all phases of aircraft design and development. Write to Joe Kuntz, Engineering Personnel, Room 12-A, Temco Aircraft Corporation, Dallas, Texas.



AIRCRAFT CORPORATION, DALLAS

IN ENGINEERING THE BEST OPPORTUNITIES ARE IN AVIATION • IN AVIATION THE BEST OPPORTUNITIES ARE AT TEMCO



NEW "RADAR RULER"

gives military surveyors an
electronic seven league sextant

PORTABLE RADAR STATIONS MEASURE AND DOUBLE CHECK 50 MILE READINGS IN SECONDS

For the first time, surveyors are freed from short-sighted optical equipment.

Unlike old-fashioned surveying tools, the "radar ruler" pierces through fog, darkness or dense foliage, electronically picking off distances of 1 to 50 miles, precise to within a few meters!

This new general-purpose surveying instrument was developed by Motorola's Military Electronics Laboratory for the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. The entire operation

can be handled easily and quickly by unskilled personnel.

This self-calibrating system uses two identical portable radar stations which bounce a signal back and forth thousands of times each second. High-speed computers automatically provide the data necessary to measure off the distance.

Now is just one more example of the equipment now being developed by Motorola for many varied military applications.

navigational devices • radar • communications • microwave systems • environmental equipment • data transmission • plotting systems • telemetering • data processing and presentation laboratory

Positions open to qualified Engineers and Physicists



2 radars and a 30 ft. electronic antenna comprise the entire equipment



MOTOROLA Communications & Electronics Division
Aircraft Division Department

6710 N. Myrtle Ave., Chicago, Ill. Other facilities: Phoenix, Arizona and Riverside, California

Rocket Powered Targets

for Pushbutton Marksman

Realistic targets for today's advanced weapons systems must be as fleet and maneuverable as the potential opponents they simulate. Small, speedy, remotely controlled drones can give pilots and gunners the combat training they require.

Powerplants to propel drones at transonic and supersonic speeds represent another important area for the application of the advanced technology resulting from **RMI POWER ENGINEERING**.

Rocket power to drive missiles and piloted aircraft higher and faster has been the prime product of RMI since its inception 35 years ago. Today, as the oldest company in the rocket engine field, Reaction Motors has a wealth of experience gained in the design and production of engines for record-holding vehicles of both types.

Engineers and Scientists creative and rewarding opportunities exist for all types of technical specialists in the research, development and production of rocket power devices. Send complete resume and salary requirements to employment manager.

PRIMARY AND AUXILIARY ROCKET POWER FOR: Missile Boosters and Sustainers, Altitude Target Drones, Ordnance Rockets, Ejection Systems, Landing Devices.



REACTION MOTORS, INC.

DENVILLE, NEW JERSEY



more examples of how

RYAN BUILDS BETTER

RAMJETS

AFTERBURNERS

TURBOJETS

PISTON ENGINES

ROCKETS

HOT PARTS TO HURDLE THE THERMAL BARRIER

High speeds in flight mean high temperatures—up to 5000°F! In this new region of intense heat where ordinary metals melt like butter, Ryan install engines are pushing back thermal barriers with every new design. And Ryan production experts are building the hottest, fastest hot parts demanded by modern aviation.

Ryan is uniquely skilled and equipped in

this important field—able to draw upon its extensive stockpile of experience in the design, research and production of higher temperature jet age items. Dramatic proof of Ryan's leadership shows up on the production lines where ramjets, afterburners, turbojets, piston and rocket engine assemblies are precision manufactured, in quantity, to the highest quality standards.

BUILDING AVIATION PROGRESS SINCE 1922

Aircraft • Power Plants • Accessories

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIF.





Perkin-Elmer is a diversified, growing young company, well known to both industry and defense circles. Why not send our personnel manager a resume of your qualifications. And if you'd like, we'll send you a copy of "Perkin-Elmer... its people, facilities, products."

Engineering and Optical Division
Perkin-Elmer Corporation
 Norwalk, Connecticut



The remote corners of the world are now accessible to aircraft designed to include the Stoukoff Paratase landing system. A product of Stoukoff research and development, Paratase with permit landings and take-offs from snow, ice, water, sand and unimproved terrain as well as standard runways. The increased versatility of the aircraft will reduce the need for conventional airports and contribute materially to the advancement of logistical techniques. The safety of the Paratase landing system, is assured by the extensive experience and complete reliability of the Stoukoff organization.



Paratase - When developed in its earliest form, the Stoukoff Paratase system enables the plane to land and take off from many types of surface without changes or additional landing equipment.



ELC - Boundary layer control as developed by Stoukoff increases the efficiency and delays the stalling of the wing, thereby reducing required speeds and distances for take-off and landings.

Achievement is a tradition at Stoukoff. Leaders in the development and design of cargo and transport aircraft, Stoukoff offers challenging opportunities to creative engineers.



Extending the Frontiers of Aircraft Performance

Stoukoff AIRCRAFT CORPORATION
 WEST TRENTON, NEW JERSEY

What's Wrong With British Aviation?

For the past several years, there has been a string tale of criticism on the state of British aviation—particularly its military products—from British aerospace engineers, military armaments and the London daily press. Britain distinguished its aviation who have spoken publicly on this topic include Sir Rex Fiddler, former president of the Royal Aeronautical Society and a distinguished aeronautical engineer; Air Commodore F. R. Baskin, an internationally recognized authority on jet engine development; William A. Watkinson, one of Britain's most experienced jet test pilots and Sir Philip Jacobson de la Ferté, a former air chief marshal of the Royal Air Force.

Our British contemporaries of the technical press, Flight and Aeroplane, also have noted that all is not well on this score and have urged action to improve matters.

The main point of all this criticism is that the Royal Air Force is now, and is likely to be for the foreseeable future, saddled with obsolete aircraft. Air Commodore Baskin made the current RAF fourth among world powers in quality of equipment, trailing the U. S. Russia and Sweden. There are indications that the present rate of progress of the French aircraft industry may push the RAF equipment down to fifth place soon.

Mary Robinson, fed a steady diet of press releases from the Society of British Aircraft Constructors' own technical staff and headlines "Britain Leads in the Air" from the pressman, was not fully aware that the Royal Air Force could not get no fighter into MG-15 in Korea capable of holding their own with the Russian MG-17. Nor are they fully aware that for the last three years the first line fighter of the Royal Air Force has been the American designed, Concordable F-8 Sabre. Now that the Hawker Hunter has finally come into front-line squadron service—"soon late," according to Air Vice Marshal Thomas Pike—it is thoroughly outclassed by the F-105 Super Sabre and MG-19 day fighter and the F-102A all-weather fighter.

These planes are superior in level flight, while the Hunter still needs a shallow dive to reach Mach 1. With the outbreak in Jordan production and cancellation of advanced supersonic all-weather fighter projects, the RAF outlook in this vital field is even worse than it is in day fighter equipment.

The greatest tactical situation is even worse with Britain already lagging at least two development generations behind the country. Bomber development is in better shape, but even Britain is puzzled as to how they limited weapons budget can support these "V" bomber programs without seriously crippling other critical development areas. Only in the gas turbine engine field is the British industry making positive daily light. Britain now has a variety of gas turbine engines covering the power spectrum from 1,000 lb. thrust to 14,000 lb., a record hard to find in any other country. But this brilliant engine development will avail little without the willingness to utilize their property and gather the precious operational experience on which British engine development must be nourished.

We do not write these sad facts to tell our British friends. The current state of British military aviation

development is a matter of deep concern to our military planners in the Pentagon and to the American people. It is not a pleasant sight to watch an ally whose military answer would be so distinguished slide down the technical scale towards obsolescence. Maintenance of a strong Royal Air Force is just as vital to the American people with their huge stake in the NATO alliance and world peace as it is to Britain.

What appears to be the trouble with the current state of British military aviation? British critics appear to agree on four principal points:

- **Lack of proper investments in the research and development tools required for exploration of the speeds and altitudes of the supersonic range of aircraft and the hypersonic range of missiles.** This includes wind tunnels, altitude chambers, test cells, and perhaps most important, as of all, a high-speed flight research program similar to the X-15 aircraft sponsored jointly by the U. S. Air Force, Navy and National Aeronautics Committee for Aeronautics.

- **Democratic bungling by the Ministry of Supply.** The critics accuse another government agency between the aircraft industry and its prime customers—the Royal Air Force and the commercial airlines. MOS control of aircraft development and procurement has led to a widening gap between RAF requirements and the equipment actually developed and built by the industry.

- **Lack of the weapons systems concept in developing new aerial weapons.** Establishing the concept in USAF and Navy aerial weapons development was no easy task against all of the forces of entrenched tradition. But, without its firm recognition, we too would still be developing aircraft rather than weapons systems. Almost every current British military aircraft is lagging, with its own added problems. The main design process is completed but forced necessary to turn a flying machine into a fighting machine.

- **Lack of genuine economic competition in the aircraft industry.** Too much of the limited approval budget is wasted on "conservative prize" prototype orders and small production orders to loosen of the technical competition in order to keep their firm alive.

No amount of effort White Paper, Whitehouse or SRAC press releases can gloss over the reality of the current hour. Britain's state of affairs has had for more practical experience with military aviation than the combined total of the official apologies.

No foreign advice will help to solve Britain's military aviation problems, nor do we propose to offer any. The British will have to make their own searching analysis of their present predicament and work out a solution within the framework of their technical and financial resources. But we earnestly beseech those most vitally concerned with British military aviation progress to "get cracking" and to get on with this vital job before it is too late. The whole future of the Western alliance and the free world depends upon having a strong, independent Royal Air Force living close formation with the British Commonwealth air forces, the French Armée de l'Air and the U. S. Air Force and Naval Aviation.

—Robert Hitts



The new 1948A Super Constellation spreads its wings! Major wing and propeller improvements planned for the new, four-engine Lockheed Super Constellation aircraft, due in 1957 more important changes in intercontinental flight. Carrying up to 2000 pounds of fuel, the new Super Constellation will

Lockheed launches 3 new aircraft!

The three new Lockheed aircraft shown on this page will also equipped with MacWhythe "Hi-Falguite" Control Cable. The wide use of MacWhythe aircraft products by leading manufacturers like Lockheed is proof of their quality and dependability.

Because it is properly PRR-formed, "Hi-Falguite" cable has proved to have no tendency to

break or cut! Assemblies can be made to slow takeovers, and there is minimum wirefracture stretch. MacWhythe makes a complete line of sizes and types of "Hi-Falguite" aircraft control cable in Galvanized, Tinned, or Stainless Steel. MacWhythe aircraft products meet the requirements of aircraft manufacturers, airlines, and military specifications.



Modern use of "Hi-Falguite" Aircraft Cable: Lockheed P-80 Shooting Star. Cable Assemblies for British Royal Air Force Blenheim, Spitfire, Mustang, and Mustang II and Mustang III and Mustang IV.



Modern use of "Hi-Falguite" Aircraft Cable: Lockheed P-80 Shooting Star. Cable Assemblies for British Royal Air Force Blenheim, Spitfire, Mustang, and Mustang II and Mustang III and Mustang IV.

2105 Featherston Avenue, Kansas, Wisconsin

MACWHYTHE

CABLE TERMINALS—ASSEMBLIES—TIE RODS

MAIL

NEW YORK: 25 West 34th St. • Pittsburgh: 101

154 Second Ave. • Chicago: 438 S. Dearborn

• Dallas: 1111 Commerce • St. Paul: 11111 11th St. • Minneapolis: 11111

Los Angeles: 31111 11th St. • San Francisco: 31111

11th St. • San Francisco: 31111 11th St. • San Francisco: 31111

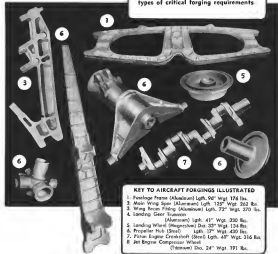
11th St. • San Francisco: 31111 11th St. • San Francisco: 31111

11th St. • San Francisco: 31111 11th St. • San Francisco: 31111



DEPENDABILITY...

Aviation engineers and designers since the beginning of the Aircraft Industry have relied on Wyman-Gordon for all types of critical forging requirements.



KEY TO AIRCRAFT FORGINGS ILLUSTRATED

1. Fuelage Frame (Aluminum) Lgh. 90" Wgt. 174 lbs.
2. Main Wing Spar (Aluminum) Lgh. 125" Wgt. 262 lbs.
3. Wing Root Fitting (Aluminum) Lgh. 72" Wgt. 270 lbs.
4. Landing Gear Truss (Aluminum) Lgh. 41" Wgt. 230 lbs.
5. Landing Wheel (Magnesium) Dia. 33" Wgt. 124 lbs.
6. Propeller Hub (Steel) Lgh. 10" Wgt. 420 lbs.
7. Piston Engine Crankshaft (Steel) Lgh. 48" Wgt. 216 lbs.
8. Jet Engine Compressor Wheel (Titanium) Dia. 24" Wgt. 371 lbs.

WYMAN-GORDON COMPANY

Established 1883

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM
WORCESTER 1, MASSACHUSETTS
HARVEY, ILLINOIS • DETROIT, MICHIGAN

WHO'S WHERE

In the Front Office

Charles H. Cohen, president of Colva Laboratories Inc. (West Orange, N. J.), director Army Air, Woodbury, N. Y.

Robert T. Oakes, company chairman, Harry Aronson Company Ltd. (New York, N. Y.)

Lawrence G. Hagerty, president, Transworld Development Co., John Wayne, Ind. Mr. Hagerty succeeds Dr. Harold L. Holt, who was president of Linton Industries, Southfield, Mich.

Byron F. Sherrill, assistant to the board chairman, Trans World Airlines Inc. Robert G. Peterson, assistant to the president and James G. Kuchner, vice president-general sales manager, Lonsdale & Seaman Co., Cleveland, Ohio

Dr. M. Schepert, vice president-general manager, Dinsdale Industries Inc., Buffalo, N. Y.

Stanley J. Kinsch, group vice president, Ray-Warner Corp., Chicago, Ill.

George G. Giesek, vice president-sales, Zeno Manufacturing Co., Detroit, Mich.

John E. Brylman, general counsel, Air Transport Association, Washington, D. C.

Guenter L. Zalkowich, working man, D. C. consulting engineer and former Navy engineer, has received the Navy Distinguished Civilian Service Award for his part in developing the Navy's new guided missile, Petrel.

Robert H. Curtis, Chairman of Air Lines Association, has been elected chairman of the Air Transport Association Meteorology Committee.

Raymond S. Ferry, president of Federal Telecommunications and Controls, has received the Air Force Trophy, the top award of the Air Force Association.

James Wang, for his contribution to a wide variety of military and commercial aircraft projects, including Trans-Hess-Buettner, president and Reg. Gen. Peter C. Seal, 48th, vice president technical director of Federal Telecommunications Laboratories, received the Wang Research and Development Award for 1956.

Dr. John E. Miller, director of defense activities for American Tool & Rubber Company, has been appointed deputy chairman of the Advisory Division of the American Ordnance Association and also elected a member of the A.O.A. National Council.

Changes

Robert M. DeHorne, associate director aircraft operations and flight test, Hughes Aircraft Co., Culver City, Calif. Also Thomas E. Curry, teachers and parts plants department head, Hughes product made laboratories.

Kenneth C. Bugh, assistant specialist director of jet engine performance projects, Republic Aircraft Corp., Farmingdale, N. Y.

Dr. George Kalla, director, assistant director research, Martin Marietta Division, National Aircraft Co., Burbank, Calif.

INDUSTRY OBSERVER

General Electric liquid-propellant rocket engine for the Vanguard and Inc. has been delivered on schedule after qualifying at a design thrust of 27,000 lbs. GE's program for the engine is on schedule, and the company foresees no problems in meeting all phases of the Vanguard test and firing data.

Waco is almost complete on five pre-production models of Dunsell's Super Mystic B2 multi-purpose fighter. Production models are due to begin rolling off the production line of Dunsell's Mustang plant in Dec. 1957. French are feverishly building 30% of the aircraft, making it the first European fighter capable of supersonic speeds, a first flight to be ordered in quantity. Powered by a Suez Air IX turbojet with afterburner, the B2 carries two 36 mm. cannon and missiles.

First Lockheed F-104A Starfighters are scheduled to go into operational service only six months after start of use of USAF's West Coast base.

Miss cargo hold of 900 sq. ft. Douglas C-112 turboprop transport is large enough to accommodate five crew-member bays. Smaller cargo hold in upper part of the "double-hulled" fuselage is believed to be almost large enough to hold a DC-8 fuselage. Specimen seats now quarters are located forward of the upper hold. Access to cockpit is by stairway from main hold. Section-mounted main landing gear is made up of four co-axial wheels. Each gear has four wheels on each side which retract 90 degrees to contact into fuselage path similar to those on C-119.

Electronic firing system for Canada's CF-105 delta-wing supersonic fighter probably will be produced by RCA-Victor Ltd. in Montreal. Development work will be carried out by RCA's De-Stavos Research Center in Princeton, N. J.

A 165-ft. high, above-ground tank for holding atomic waste and air-dropped antimatter weapons is scheduled to go into service this week at the Naval Ordnance Laboratory, Silver Spring, Md. The tank, 50 ft. in diameter, allows better control and observation of test results, easier removal of test items than fittings in barrels and access. Hydrogenous, stainless-steel, and titanium of certain propellants and propellants can be tested. Facilities allow for photographs. A wood-and-steel platform forms a "false bottom" for tank, can be raised or lowered to vary depth of test.

Begert 3100 Tacon, lightweight tactical support fighter, has been designed to follow the area rule concept. The aircraft, to be powered by a Bristol Ophion engine, is scheduled to make its first flight sometime this summer.

Shockley has tripled the skin thickness on commercial version of its 4-54 helicopter, adding 150 lb. to the empty weight of the aircraft. Rear compartment of the helicopter, originally designed for electronic gear, has been converted into passenger space, and the electronic gear is now stored beneath the pilot's compartment.

Closed-circuit television of instrument radio maps to Fiat and Cold Com stations is being considered by the Weather Bureau. System would permit local meteorologists to view and hand the program and the report of a storm. Television signal can be transmitted over a 3,000-mile cable phase wire to a slow wave receiver with strong tube. Bureau also might extend coverage to the Midwest tornado area.

Hughes-Aircraft S. A. is designing a four-engine liaison plane derived from its RA-306 R-1 bomber. Powered by four Pratt & Whitney engines, the aircraft has the company designation of RA-373 R-1. Military designation is XL-11.



From V-2 type to Talos

AMF has missile experience you can use

From the earliest missile types to the latest and most advanced developments, AMF has made major contributions to America's missile programs. And today AMF is actively participating in more than half the programs under way. One of its subsidiaries, Associated Missile Products Corporation, is the only private company devoted solely to missile support equipment. And AMF's missile experience covers practically every stage of design, development, and production...including mechanical and electronic test equipment...payload power supplies...load and ejector handling equipment...launchers...ground and flight control systems. So for yourself why AMF's experience in missiles, as well as in a host of other fields, has made it the "can-do" company.

Research Development
Production in Basic Missile
• Guidance
• Airframe
• Outer Structure
• Control Systems
• Auxiliary Power
• Control Systems



Defense Products Group
AMERICAN MACHINE & FOUNDRY COMPANY
1101 North Royal Street, Alexandria, Va.



Washington Roundup

Army Steals Missile March

Army has stolen a march on its sister services in the belated missile race by demonstrating the technical advances made in such steps, long-range rocket firing. The Army Ballistic Missile Agency, as part of a planned program leading to the Jupiter intermediate-range ballistic missile, has laid a three-stage rocket for a distance of 3,000 mi from the Air Force Missile Test Center at Patrick AFB, Fla.

The first stage, a TS-003-40 thrust Redstone power unit, plunged into the air 200 miles from the launching site. The second stage, a cluster of four Bolo Sergeant model propellant rockets, hit 500 miles from the launch point. Third stage was a single Bolo Sergeant which hit about 3,000 mi, descending "within the target area" according to official sources. Pay an optimum ballistic trajectory of five miles, the peak altitude could be expected to approach 600 miles. Primary purpose of the firing was to check stage separation techniques.

Second Thoughts

After Arthur W. Radford, chairman of the Joint Chiefs of Staff who four months ago termed warnings of the Soviet Union's military capabilities "almost irrational" in some reports, and last week that recent Russian atomic advances were "something of a shock," speaking at a Harvard International Ambition Award luncheon here, Adm. Radford warned:

"The anxiety with which the Soviets developed their long-range jet bombers and their atomic weapons has been something of a shock to the free nations."

"Such rapid developments in jet bombers and atomic weapons," he added, "demonstrate that their present technological emphasis is devoted to the military application of power as an instrument of war."

Totalling before the Senate Subcommittee on the Air Force in June, the admiral said, "I think we are in a dangerous position vis-a-vis the Communists...today because there has been an almost hysterical conception of great capabilities on the part of the Communists, some of which, in my opinion, actually do not exist."

Censors Roise Military Hoaxes

Mounting Pentagon resentment against petty censorship in colorful tales of Assistant Defense Secretary Robert Tappan Ross is reported to have come to the attention of the top line. Secretary of Defense Robert McNamara and civilian officials, all of them high ranking, have been forced to submit to changes in their speeches put there by Ross' assistant, Donald B. McClelland and Philip K. Allen.

Most recently, Army Chief of Staff Gen. Maxwell D. Taylor, commander of 1,015,000 men, had a speech returned from McClelland's desk with about 100 petty alterations. Previously, Army Secretary Wilbur Brantley had a speech pamphlet, killed by Ross, passed in the office of the Assistant Secretary for Legislative and Public Affairs, Mr. Brantley, an experienced attorney and former governor of Michigan, received indignation.

The Air Force, too, has had its troubles. Gen. Nathan Twining, chief of staff, and USAF Secretary, Donald Douglas, conducted a running campaign with Ross' office, trying to tell the Air Force, when through, exactly, policy and grammatical mistakes introduced by the

letter. USAF speech writers now have resorted to using during air lectures an official on-site who can get by McClelland, executive assistant to Ross, but a lack ground of access to public relations work for chemical manufacturers in New England. Allen, strong Republican party leader and former member of the legislature in Massachusetts, has been employed at Harvard.

Stock Hearings

The Senate Permanent Investigating Subcommittee will hold "extensive public hearings" on the "war future" on the heavy trading of Northeast Airlines stock on Aug. 7—the morning after the Civil Aeronautics Board awarded a Miami-New York route to the carrier in successive stages. It was another week before the decision was made public.

After several weeks study, the subcommittee staff has developed sufficient confidence in regulations to warrant the hearings. The main problem is to get senators in the subcommittee together in Washington. Sen. John Williams (R-De.) called for the investigation to see that the question is to also include advance information does not remain unanswered.

Robert Griffith, assistant to the president of Delta Air Lines is scheduled to be a key witness at the hearings. Several of the 21 CAB members and CAB staff members present at the session on the Northeast Airlines will be called. Delta had been recommended by a CAB executive to receive the route.

The subcommittee is headed by Sen. John McGeehan.

Curtis Favors New Airport Group

A national organization with the authority to implement an airport plan that will meet the approval of both Congress and seem to have been urged by Edward Curtis, special assistant to the President for aviation facilities planning, in a statement before the Senate Subcommittee on Aircraft. Curtis said there is a need for an overall plan for an airport system that will give airport agencies some guidance in planning proper runway lengths, high speed turn-off requirements and facilities. He called for a cost estimate on airport planning to permit an equitable distribution of costs between federal, state and municipal agencies and the airport users.

Another CAB Investigation

The Civil Aeronautics Board last week added to its growing list of airline investigations when it voted to launch a review of Air Traffic Conference and International Air Transport Association agreements. Air has travel agent agreements came under fire at hearings held last Spring by the House Aviation Subcommittee. Since then, the Board has continued to receive criticism from travel agents and congressmen, and now an investigation of the issue has been mandated.

An Transport Association President Stuart G. Tipton predicts the investigation will show the agreements are a good job of protecting the public. He points out that the union have to exercise a certain degree of care to make sure that agents representing the airlines are trustworthy, and that the CAB has always approved the agreements when they have been reviewed in the past.

—Washington staff

USAF Pushes Maintenance Demands

Maintainability requirement may be written into all contracts; jet engine makers to feel change first.

By Claude Witte

Washington—USAF jet engine manufacturers next year may be called upon to accept the first Air Force contracts to include maintainability specifications.

The specifications will call for reliability in the design of features that will ease the burden on USAF personnel in the field. In addition to describing the maintainability requirements, they will spell out the procedures by which the Air Force will determine that the requirements have been met.

The real importance of the jet engine maintainability initiative was pointed out last week at an informal symposium held at Tinker AFB, Oklahoma City (see page 31). While representatives from the jet engine makers and the Air Force were given a staggering array of figures on costs and the time taken to build engines to keep up and outpace competitors in top conditions.

Information available to Aviation Week indicates that USAF's plan to write maintainability specifications into jet engine contracts still is in the early stages. One spokesman said the idea is being "baked with" the other kind, it is clear from what was disclosed at Oklahoma City and from the facts about skill shortages at the Air Force that there is a serious and necessary.

Industry Awaits of Problem

Complaints, dozens of requests for maintenance in new jets will be the last step towards an eventual, revised policy to include such specifications in all weapon systems and component contracts.

At the same time, USAF already is giving credit to the aircraft industry for meeting the requirements of its current maintenance problems and asking to have it. Complex aircraft now on the drawing boards of major U.S. aircraft plants, have costly improvements, maintenance, increasing the requirements for skilled manpower, extensive training, special tools, not gear and facilities.

Seriously, immediate identification of these projects and details on what has been considered to help USAF meet this contract renders in an act of giving compliance, and skill shortages. But both the Air Force and Defense Department are the charges in a risk of a two-year effort to make maintenance more aware of the problem.

A growing number of aircraft types, particularly the larger ones, now have maintenance experts "latching" over

the shoulders of weapon system design on Lockheed, for example, has a special group to handle jet engine and the "tech rep group"—the group is close with all new projects to protect the USAF mechanic from unnecessary complaints in time design.

Where Problem Lies

Converse, Douglas, North American and others have taken similar action. Usually, the groups are called "Maintenance Engineering" or "Maintenance Engineering" and are charged with the responsibility of engineering and performance design staffs.

Some of their early efforts already are paying off in maintenance improvements on such aircraft as the C-130, the F-100, the Lockheed F-104 and Douglas C-119.

In a letter to the Aircraft Industries Association last April, Gen. Clarence S. Adams, deputy chief of staff for air, declared that a large portion of the increase in maintenance "is due to health problems." He worried that the Air Force will give maintenance "more weight" in the selection of future equipment.

Industry reaction to this announcement was mixed. Some major companies already had taken steps along the lines called for by Gen. Adams. Others were in the approval of the advanced airplanes as to USAF's attitude.

Most common complaint is that, while it comes to pecking the wings as a design competition performance and weight have been the making criteria.

The contracting effort, according to these observers, is looking for maximum performance, maximum weight and cost.

Performance Cost

When jet, maintenance is built into a weapon system it can result in added weight and cost, slightly poorer performance. The cost should be a major factor because cost maintenance can get increasing expensive enough to make that the added initial outlay for the equipment.

Some contractors contend that there is no competition because of restrictions made in the interest of new maintenance.

Gen. Adams' letter indicates that USAF is determined to correct this condition. The step undoubtedly can be found in page part to meet new current equipment with new aircraft

in the North American F-100.

In the case of the F-100, only a year ago the first aircraft out (the 48th Fighter Day Wing) was almost handicapped because it did not have sufficient skilled personnel to keep the Douglas Constantine fighter operational (AW Dec 10, p. 14).

The second on the F-100 has been repaired, but only because of USAF's strong in the job training program and personnel, provided by the manufacturer under contract.

North American personnel are based with the planes both in the U.S. and abroad.

Accuracy is the major problem in the USAF mechanic. Other factors in the simplicity of the action itself: the checking system and the timing required. Changes in any of these, even from proven practices, actually can affect reliability. And reliability, in the long run, is just as important in maintainability.

Figures obtained from a reliable source indicate that the average F-100 still requires better than 90 man hours of maintenance work for every flying hour.

On the F-100, for example, it is necessary to remove the engine in order to do the scheduled work on the constant speed drive. This means that that one job can consume as much as 37 man hours a figure that could be cut by an estimated 75% if the design were different.

Jet-Engine Problems

Other common complaints against USAF equipment include such obvious things as accessibility of the fuel supply, the oil and water. One source, according to our report, it is almost too difficult to work on vital parts of the engine to disassemble, but the present equipment is better.

Just as the contract program is expected to start with future engine designs, all component manufacturers will face more pressure from the USAF and the Defense Department to learn to ease the maintenance effort.

Jet engines are a clear starting point for this effort because two life attention has been given to field replacement on key items in the competition contribution and turbine core. Design with these things in mind, it has been estimated, could cut down on repair overhead by a substantial degree.

The Air Force program to improve the maintenance situation actually goes back to the spring of 1955, when Gen. F. V. Ruskopf, chief of the Air Materiel Command, told the Air Staff that the maintenance problem was the worst of the war years. USAF

still levels and the complex aircraft he was buying.

A staff study was conducted and set out at a symposium August 1955, first issued in September 1955, and revised in June of this year.

Maintenance in Design

AIR R-29 calls for assistance features to be built into a design and outline AMC and the Air Research and Development Command to monitor projects for this purpose. It provides for maintenance engineering personnel in working and continuing technical complexity inspection boards. At the outset, the program was hampered by the fact that the Air Force had less personnel compared to jet maintenance logs on the design.

About a year ago, the Defense Department's Office of Applications Engineering was given overall responsibility of a similar project to serve all branches of the armed forces and all equipment. This office now has a committee working out a Defense Department policy to effect conformity in the approach. It is expected that in about a year, maintainability provisions will be made standard in all defense equipment contracts.

Low Cost Helicopter To Challenge Industry

Washington—U.S. Army will throw a major challenge at the helicopter industry next year with a design competition for an observation helicopter with a price tag at the \$10,000 range.

Mr. Gen. Hamilton H. Brown, Army Assistant Director, says the new aircraft must be simple and small. The requirement is that it cost a third of the present observation helicopters and enter that with a relatively new design will fill the specifications.

In an address at the annual meeting of the Army of the U.S. Army last week, Gen. Brown listed these other requirements:

- High-performance, fixed-wing aircraft with a speed of 275 to 300 knots, able to land and take off over a 500 ft obstacle within 600 ft. Now in design competition, it should be available by 1960.
- Fixed-wing, single plane capable of carrying a 24-in payload. Carrying weight, 200 knots, 100 knots and landing weight 500 ft. A standard fixed-wing transport should have a speed of about 210 knots.
- New utility helicopter. This is the Bell UH-1H that will fly within the next few months. It will be replaced by a new design, it will carry 1000 lbs and carry a 1,000 lb payload.
- Medium class helicopter for a payload of three tons, also powered by



Ground and Horse

Worked-out building helicopters of the Bureau of Army Engineers, showing loading and carrying capacity. HO4S (above) has classified down under the full name, can carry 10,000 lbs. UH-1H (below) has classified down under the full name, can carry 10,000 lbs. UH-1H (below) has classified down under the full name, can carry 10,000 lbs.

two-shaft engines. Proposals are being considered. One of them is the Vertol turbine-powered H-21.

- Flying crane for heavy loads of eight to 10 tons. Now being studied by the industry, a design competition is expected next year.
- "Aerial jeep," to weigh 1,000 lb and carry an equal payload. There will be a design competition this year, and the vehicle should be ready by troop test by 1959.

British Air Official Replies to Criticism

Proponents of bomber types at the Bristol Vickers in the U.S. is opposed. Nigel Birch, British Secretary of State for Air and is likely to improve that in quality of equipment the Royal Air Force makes better America, Russia and Sweden (see page 21).

"English is extremely long-winded, which we do not mind," Birch said. "I believe that our V bombers have a better performance in speed, height, even range, and maneuverability than their United States and Russian counterparts."

"The Swedes have no medium or heavy bombers. Moreover, the Swedes are busy having our fighter fighters, which hardly looks as if they share the black views of some people here at home."

An Commodore F. R. Banks, a director of the Bristol Aeroplane Co., in making the RAF equipment fourth, had suggested the British look to American industrial techniques for assistance in Britain (AW Dec 22, p. 31).

Banks said that British present aircraft methods had been unimproved since 1932, and that he intended to try to improve them further.



LATEST Tiger in flight shows wing root and tail extensions characteristic of this modification of the supersonic fighters.



REAR VIEW shows enlarged fuselage around the J79 installation (above). Inlet ducts suit an intake rather than exhaust system by controlling the engine jet exhaust area during various power conditions. An intake has advantages of simplicity and lack of maintenance holes in the hot bleed air the exhaust. Other changes to modified Tiger include a re-built air intake to take the larger diameter of the afterburner, increased capacity for the intake ducts, wing leading edge extensions at the root and a single piece clean, reinforced replacing the original three piece design.



J79 Demands Larger Fuselage for F11F

LATEST version on the General Electric Tiger thrust is the F11F-1F, powered by a General Electric J79 turbojet with afterburner. Thrust rating of the engine without afterburning is about 13,000 lb. Two prototype 1Fs have been built and are being flown at Edwards AFB, Calif. Production Tiger with Wright J65 is supersonic in level flight, 1F is subsonically faster.



BILLY pilot of F11F-1F shows external changes: extended wing, leading edge, modified rear fuselage and new engine inlet ducts.

Airlines Advised to Contract Jet Overhaul

By Irving Stone

Titanic AFB, Okla.—U.S. airline maintenance experts were introduced to the complexities of the jet engine last week, and advised to let contractors do their overhaul work, particularly in the early phases of the jet transport age.

Dealt with a flood of opening statements drawn from USAF's experts, the airline organizations were given a second briefing on what they can expect in testing costs and manpower problems when their shops face jet engine overhaul. The preview was given at a symposium sponsored by the Oklahoma City Air Mobility Area for the Air Transport Association.

Overhaul Headaches

Examples of some jet overhaul headaches revealed by the USAF experts: • General Electric J79 will require an average of 2,400 man-hours for complete overhaul, although the time may be cut before the engine enters commercial service. Overhaul cost is about \$71,000. The J79 will be used in Convair's 580 jet transport.

• Pratt & Whitney J57. Overhaul time is 1,072 man-hours, not including J73 fix for inspection. Material cost averages \$15,000. A facility to overhaul 30 engines a month would cost about \$42,700,000. The J57 will be used on some models of the Boeing 737 and Douglas DC-8.

• Allison T56 turbo-prop. Overhaul time has been estimated at 1,000 man-hours. The Lockheed C-119 has 50 in its 306 hp. Power plants can be changed in three hours in this aircraft. The T56 will be used in the Lockheed Electra.

More than 200 representatives at the symposium, Civil Aeronautics Administration and USAF engineers attended the meeting. "Recent power plants are getting bigger and bigger," which has a 17-stage single-rod engine compared with earlier four-stroke piston engines in the first area stages.

There are 10 maintenance chambers on an airplane transport section and a three-stage turbine in use at the discretion of the engine caused by the difficult initial design, structural assembly and disassembly is being done at overhaul facilities. Horizontal cutouts are being used by field activities. Limited studies of horizontal cutouts have shown that 90% more man-hours are required than that needed for vertical cutouts. Those also are indications that horizontal testing cuts have 45% more man-hours at least 10% more than vertical designs because of test and design.

Only three engines have been reconditioned and actual test factors for the various overhaul plans have not been completed. Cost for overhaul, according to R. M. Hannon, OCAMA jet engine technicians, is about \$71,000 per engine.

In overhaul 50 engines a month is an estimated 150,000 sq ft of floor space. Inspection of the maintenance chambers requires about 40 workmen, according to Hannon. Rephrasing and rigging of the main fuel control takes about 30 man-hours.

"Today," Hannon said, "we can say that if our maintenance chambers and outside shop space were located at least 20 hr of flight time the month would require more or replacement prior to further service."

Hannon said that conditions are being created through parts delivery and that by October 1977 J79 jet air test parts should be in good as these are other engines.

Referring to commercial jet operations generally, Hannon cautioned: "Operators are inexperienced as to how jet parts can and by all means the use of jet with metal bellows in the case of cooling air-passing and oil system lines."

Metals bellows have been a sore spot in USAF jet engines generally. There are more on the J79, and they fail frequently, Hannon said. The trouble there comes from vibration.

Wait for Data

W. C. Doyle, OCAMA lightning support planner, told the meeting that if the J79 is jet engine use he is seen much concerned for insurance, not overhaul cost. Facilities should be studied for overhaul with contractor furnished parts only. Each time in special tests, technical information, spare parts, support and parts consumption data will have been finally established and made available.

Highlights of OCAMA's Pratt & Whitney J79 overhaul and maintenance were outlined by H. Vandenberg, jet engine technicians who pointed out that the information was available to the engine manufacturers would be of considerable assistance to the proper use of commercial facilities.

Since the 15,000 engineering changes have been noted on J79 design, there have resulted in publication of more than 225 service bulletins. Most, thus 110 overhaul changes have been, or are in the process of being published. About 75 service engineering orders have been noted by OCAMA.

Elapsed time in overhaul is 31 days on a one-shift basis, while elapsed working time to completely overhaul the J57, including test, is 24 days on a one-shift basis.

Total spare requirements for J57 overhaul, including storage, is 168,832 sq ft. Cost of materials in overhaul of the average engine is \$15,000, with a low range at \$12,000 and a high value of \$18,000.

Typical stage of inspection for highest engine component is approximately 75% on an overall basis, except for compressor blades, turbine blades and turbine vane, which is about 20%.

Facility Costs

Cost of building and equipping an overhaul facility capable of handling 30 engines a month is estimated at \$4,750,000. This would include such items as \$1,507,800 for equipment and tools (including standard hand tools), \$620,000 for accuracy overhaul and test, \$300,000 for test tools and equipment.

Engineer at Castle AFB, Calif., for the first test of Boeing B-72 operation reveals that there were a total of 61 J57 engines, passenger, removed. Cases were eight for high exhaust gas temperature, 15 for foreign object damage, seven for turbine vane damage, eight for oil leaks, three for oil system malfunctions, five for turbine vane damage and 17 for miscellaneous damage.

From June 18, 1965, to Oct. 18, 1976, the B-72s have shakedown 10,154 hours of operational flight time. This is equivalent to 81,972 engine hours. Until June 1976, engine had been overhauled 500 hr. They were later increased to 600 hr and, just this month, increased to 500 hr.

One major problem with the J57, Vandenberg reported, is that of oil leakage. It is a bearing system and leaking of oil in the pump cavity. Coloring is more pronounced on afterburner engine because of additional heat generated at the pump.

A change has been submitted to provide a heat shield around the pump, and this has delayed initial buildup. Engine oil is changed every 100 hr. Development of an oil that would withstand higher temperatures might eliminate the oiling problem.

While foreign object damage remains a permanent cause for removal of the J57, Vandenberg points out the record of this engine is relatively good and percentage of overhaul is smaller than originally expected.

As twice experience with all jet

of gas turbine engines indicates that approximately 40% of all overhaul is due to foreign object damage. J57 overhaul for foreign object damage, however, are approximately 10%.

Permissible inspection of the B-72 with the J57 engine, without afterburner was originally established at 100 flight hr intervals. This was recently increased to 200 hr of engine operating time. This increase, however, is contingent upon an exhaust gas temperature check and a fuel pressure differential check being conducted at each 100 hr interval to determine fuel manifold and nozzle condition.

Periodic inspections include a check of the last action, which reveals the internal condition of the engine. Removal of the engine from the aircraft is required and the overhaul time for a full section inspection is 25 man-hours.

Boeing has introduced a change with respect to establishment of the J57-P1W1 to include run-out programs. If the change is approved, it is expected to save between two and four man-hours of inspection time.

Overhaul Time

Vandenberg reported that, in the last engine inspection, maintenance shops for allowable crack limit is 1/8 in. diameter hole for overhaul during a periodic inspection of the J57 is 50 man-hours, or about two days of elapsed time.

As an indication of what a periodic inspection can reveal, Vandenberg reported on the period between June 1 and Aug. 31, when 17 aircraft with A series engines J57-P1 and J59 under serial periodic inspection. Based upon 180 hr of operation between inspections, the figures are 1,700 man-hours, or 13,600 hr of engine operation for the eight engines.

During the last-engine inspection of the J59 engines, one engine was found for lowest first-stage stator guide



NO. 1 PROPPELLER washdown. No. 4 is installed in Stratocruiser glider towed water.



TAIL section looks away when Stratocruiser landed. Note tail-down attitude (below).



AIRCRAFT landed 26 min., allowing 24 passengers and seven crewmen to get into raft.

Stratocruiser Is Ditched

Five American World Airways Boeing Stratocruiser was ditched midway between Honolulu and San Francisco Oct. 16. Five hours out of Honolulu No. 1 propeller began to wobble, and when the engine was stopped the propeller assembly and hub were damaged.

Four engine test power, and Capt. E. N. Ogg decided to ditch and ditch by the ship "N" the Coast Guard cutter (Providence). Capt. Ogg would nearly five hours waiting for daylight, floating fuel. Cutter laid stop of the emergency from on sea to take on and help pilot's depth perception.

ness and two far stripped conventional rods. Before construction can also be rejected.

Over the same period, 11 aircraft with Rotax P15 P15W four-cylinder engine inspection. During 85 test hours, 40 engines were rejected, but 34 construction can meet.

From June 19 to Sept 7 six Avian engines were previously rejected in addition to those that did not pass inspection. Two were rejected for excessive exhaust gas temperature, two for oil leaks at No. 5 bearing, one for a cracked crank and one for faulty inlet multibushings. During the same period, only three three-cylinder engines were previously rejected—two for oil leaks and one for oil-fuel electrical wiring.

Various other causes for rejection for a special inspection. Should the exhaust temperature exceed 610°C for five seconds or less during starting or 590°C for five seconds or less during acceleration but fail to exceed 700°C, the engine is rejected for evidence of rubbing or damaged blades or vanes, heat retention of high and low stage compressor ratios (both as an evidence of present and future fault) for leaks, cracks or distortion of compressor cases, cracks, heat damage, excessive buckling or warping of burner cans. If the temperature remained outside the five-second time limit, the engine is rejected.

T36 Engines

An three engines with the Allison T36 turboprop engine in field maintenance and overhaul was ordered by OGCMA's B. E. Davis.

As of Oct 1, approximately 150 major production design changes had been incorporated into the new production engines. About 55 of these have required modification of the engine production engines.

Medium gas assemblies can be replaced in approximately two hours by three men. Torque-meter assembly, which does not require removal of an specified panel can be replaced by three men in approximately three hours.

Although several thousand flying hours have been chalked up on the T36, one little area of field maintenance repair has been done. Then is because the engine and the Lockheed C-130's it powers have not yet been released for organizational operations. A field maintenance program will be implemented at one time in December.

At the present time, the complete turbine rotor assembly has to be replaced as a unit whenever a turbine blade or assembly component part is damaged beyond limits. This is because the design separates assembly as dry high pressure.

Also, very little welding of combustion

free section parts is now permitted, because sufficient experience is not yet available to establish inspection limits.

Replacement of the compressor rotor cannot be accomplished in field, although bleeding of some seals and debris in specific areas of the rotor blades can be done.

All internal parts and accessories are replaced. Reduction gear in engine is very limited, with the safety coupling being the only internal part permitted to be replaced except at overhaul.

Torque-meter Repair

The torque-meter can only be repaired at the overhaul depot. Experts can indicate that the torque-meter is the engine will be in the field within and collection gear smoothly. Thus far, overhaul of the T36 and compressor has been restricted to complete overhaul at the manufacturer's plant.

As of Sept 1, there had been 17 power units and 42 reduction gear assemblies overhauled. Each power unit overhaul costs \$5,555 and overhaul cost for each reduction gear and torque-meter is \$3,255. These costs include labor, plant facilities and material factors' profit.

It is expected that the San Antonio Air Material unit will be ready to overhaul the T36 code in 1987. Inspection requirements of engine parts, particularly those subjected to high heat and fatigue concentrations, have been and will be a problem.

Those parts on the T36, as well as those in other engines are supported by inspection and fluorescent penetrant methods, considered best methods available.

Overhaul of the reduction gear assembly is much more complex and costly than the gearbox used for a reciprocating engine reduction gear. High horsepower and speed reduction involved call for close fits and clearances.

Many of the major components of the reduction gear assembly are manufactured in complete subunits and when one part is damaged, the complete subunit must be replaced.

Highlights of an assembly overhaul and test were presented by L. M. Cook, who pointed out that it required 40 man-hours to make a T37 fuel control assembly.

A jet engine fuel control test stand costs \$75,000 as compared with \$10,000 for a carburetor test stand. About 240 testing hours are required to operate a jet engine main fuel control stand as opposed to 70 hours for a carburetor test stand.

It requires approximately 720 lb to turn a test bench operator to only

about a jet new fuel control as compared with 240 lb to turn for collecting a carburetor.

Approximately 162 man-hours are required to overhaul and test the T37 engine assembly. As an example of one unit, Cook cited the JPC-12 model same fuel control which requires about 34 man-hours for the overhaul sequence in comparison with 10 man-hours for the power collection.

The test of the control about 16 man-hours are required. Approximately 125 of fuel control are required for engine collection and an additional 25 are required at time of engine test.

Two types of method are presently being utilized—progressive overhaul and overhaul overhaul. The type or frequency of types selected is left to the discretion of shop management. The T37 fuel control overhaul is being accomplished now in the overhaul facility. The machine indicates real complete test later sequence.

Static Testing

Although latest testing of accessories may be accomplished through the overhaul facility, engine accessories are tested under static conditions which actually produce the engine operating conditions and as receiving passengers.

Basic rule for static testing is the observation of all possible variables. Hence, test equipment has been designed to give extreme sensors for the manual setting of specific test conditions.

For example, main fuel control system is set manually for 1 of 15 accessories. Fuel temperature probe, gears, and sensors are monitored in specific levels. Fuel flow to the fuel control is manually controlled to an accuracy afforded by the best available flow meter equipment.

News Digest

Prof. David Clements, 55, is associate dean of the Princeton University School of Engineering and director of the James Forrestal Research Center, died Oct. 19. He was assistant editor and later associate editor of *American Machinist* from 1935 to 1959. The magazine was later combined with four others to form *Aviation Week*.

Office of Naval Research has scheduled the first high-altitude flight of its unmanned space laboratory (Stratos Lab) to collect stratospheric data at a site above the University of Minnesota. The Stratos Lab, with two observers and attached to a Stratolab plane, is expected to reach an altitude of 75,000

ACTUATORS with a difference



Can you use

- A curved pneumatic Actuator
- Almost infinite stroke
- Travel equal to total length

Five piston pneumatic actuators—defined "pneumatic" as they have no piston rod. Thousands are in use for cushioning of motion from impact. These pneumatic actuators are capable of holding deflated items—such as parachutes—until high speed inflation. When cushioning fragile components. We think that their unique principle—flex without performance—deserves more than to be used in the narrow to difficult situations problems, particularly where long stroke is required in a confined area.

Here is a challenge to your imagination.

These characteristics—other functions—can you see them?

- Stroke nearly equal to total package length
- Piston rod through air seal
- Allow approach—rapid retracting stroke
- High temperature capability
- No limit on length
- Long life—no seals or glands to wear
- Lightweight
- Wide pressure range—20 to 1500 psi
- Tube can carry structural load or be part of structure

If your actuating requirements will be one or more of these features, Stratos "pneumatic" may be the answer. Write to Stratos World Branch at 1800 Bessie Avenue, Manhattan Beach, Calif. 90263 for a literature problem.

Stratos World Branch also makes Compressed Airways • 3000 psi Compressors • Deflated Valves • Controls • More

STRATOS

A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION

Main Plant: Box 300, L. J. N. Y.

West Coast Office: 144 Vermont Blvd., Los Angeles, California.

Western Branch: 1800 Bessie Ave., Manhattan Beach, Calif.



Schematic of unpowered actuator showing how piston plate seating (cushioning) valve air

34

AVIATION WEEK, October 25, 1976

Airline Growth Indicates Healthy Profits

Third-quarter trends point to 14% gain in traffic for 1956 despite slow start in travel last summer.

By Craig Lewis

Washington—Gains in airline traffic made during the past summer show that the industry is continuing a 1916 pattern of steady growth that should give the current a healthy profit margin by the end of the year.

After a disappointing start, summer season traffic picked up in August and September, and the trend through the first half and third quarter of 1956 indicates that airline traffic will show a 14-15% gain this year.

Profits for the industry as a whole are now growing as fast as traffic and revenues because of rising cost levels and continued deflation of fuel costs, which will in the intermediate term offset losses by a few carriers. In addition, however, are that profits will at least maintain their 1955 levels.

Trunk airlines are showing a lower rate of growth than international and local service carriers, although that is to be expected. Trunk line traffic has averaged a fairly steady year-over-year growth of about 11%, in terms of passengers, in the last year.

International Gains

International airfares worked up substantial gains last summer after a disappointing start in July. Across the Atlantic, for instance, Pan American World Airways' traffic increased only 6% in July, then gained 23% in August. Trans World Airlines' revenue rose 17% and 14% for the same months.

In the Pacific area, Pan American's traffic increased 21% in the first eight months of the year, and Northwest's traffic rose up 15%. Since Pan Am's carriers expanded only 19% and Northwest made no capacity increase, these gains have improved load factors.

The local service airlines continue to grow faster, their rates being higher, but the rate of growth is tapering off somewhat. Thus for this year, feeder-line traffic has grown about 27% (increases in capacity, including introduction of Convair and Martin transports, also have slowed the growth of load factor).

The trunk airlines went into the third quarter of 1956 riding the crest of the greatest traffic month they had ever experienced. The first half of the year has shown a steady increase in air above expectations and above the

industry load factor up to 73.7%. After this expansion, July itself was a solid performer. During the first month of the third quarter, traffic grew only 6.7%, a rate far below the year-long average growth.

July Traffic Drop

The carrier noted that traffic dip on various factors, including the weekend long strike which cut into both westward and eastward traffic. The fourth week of July holiday came during the month, cutting vacation travel.

Undoubtedly, the major factor in the July traffic situation was the collision over the Grand Canyon between TWA and United East Line transport on July 30.

Traffic picked up again in August. When July load factors dropped from 61.2% in 1955 to 61.2% in 1956, August load factors averaged 69%—about the same as August 1955. And, though August load factors were cutback in the face of a 1956 season in capacity, the favorable trend can be seen in September.

Carriers' losses in ending substantial gains this year following a slow year in 1955. Last year's work traffic was just under 35% of total trunk line passenger miles. In the first quarter of 1956, the crash during the first quarter moved up to 39% of the total, and it may grow to 42% by the year's end.

Carriers' traffic made substantial gains in July, when it increased 11% over July of 1955. It was up 16% in August and 15.5% in the first eight months against an overall traffic increase of 12.6% for the eight months period.

This record in airline traffic means continued decline of an average 4% more passengers per load factor. On the other hand, the average load factor per mile decrease. Along with this, expenses are continuing to rise as fast, in fact, than revenues. These factors being taken into account, the rate of growth in revenue and traffic, with the result that profits tend to stay at the same level while other categories are rising. In spite of this trend, the profit position of most of the trunk carriers is healthy.

The airlines' prospects for the fourth quarter and for the first part of next year continue to look good, largely because passengers for the national carriers are healthy.

As expected, the national economy

levelled off somewhat in the third quarter. Although the Great National Product showed a substantial increase, the increases were mostly in prices rather than in business activity.

Now, business activity is moving up again in the fourth quarter, and the rate is expected to continue into the first quarter of 1957. The rise in activity is being led by industry's capital spending, although consumer spending is leading personal spending.

While the airlines depend heavily upon the consumer's confidence in his spending, the increase in capital spending is good news, too, because this business spending is the type that provides more business travel.

First third quarter reports from trunk lines show varied results. American Airlines reports total earnings of \$13,070,000 for the first nine months of 1956, including \$1,317,000 from air of itself. Profit for the same period last year was \$14,537,000.

American's total revenues were up 11.7% in the first nine months to \$217,251,000. Traffic increased 11% to 1,897,014,000 passenger-miles.

United Reports Gains

United reports similar gains. Earnings for Sept. 30 are \$21,355,544, including a \$1,271,888 gain from aircraft sales. Earnings for the 1955 period were \$10,011,469. The airline's profit in the third quarter was \$2,124,569, compared with \$1,719,229 last year.

United's revenues increased 9% in the third quarter and 12% in the first nine months of the year to \$23,827,540 and \$230,840,000. Expenses rose 11% and 12% in the same periods, but the airline was well equipped have actually been kept below 1955 levels.

Passenger traffic was up 10% on United's trunk line in the third quarter and gained 11% in the first nine months of the year. United's trunk traffic made the bulk of the gains, with a 31% increase in the first nine months of the year. Feeder-line traffic made up 5%.

Delta Air Lines reports its revenue for September to \$17,835,000 in the July-September period, although net income slipped from \$651,923 in the 1955 quarter to \$487,576 in the 1956 period. Delta's revenue increased 30% and net income for month rose up 34%.

Delta's growth cut that 19% of the net capacity is operated in the quarter was in the new Washington and New York markets which the carrier is still developing. Delta's overall revenue for the quarter is expected to improve

Delta's overall profit situation.

Capital Airlines remains one of the few trunklines not reporting fourth-quarter figures, although the carrier thinks it has turned the corner on its operating losses and will soon begin to show up in the profit column.

In the first nine months, Capital had an operating loss of \$7,170,000, compared with an operating profit of \$915,147 in the 1955 period. The addition of special charges brings the loss to \$5,281,000 for the nine-month period.

Vacuum Capacity

Capital has faced two sets of extraordinary charges in the past six months. In addition, the carrier's capacity is being tested by the DC-3, DC-4 and Constellation's high level of the Vacuums' capacity is being tested. This added cost has served to keep capacity load factors down to about 70%. Capital has required passenger traffic gains—17% in September.

The recent expense has been expected of airline losses for the year, but the carrier's loss recovered when the Civil Aeronautics Board managed the carriers' route structure in a series of route cuts.

Capital had an operating profit of \$44,000 and a net profit of \$59,000 in September, and the carrier began this year's work, the end of the period of heavy losses which came with the carrier's program. Since the fourth quarter

BOAC Can Buy 707s

London—British government will seek permission to British Overseas Airways Corp. (BOAC) to buy 30 Boeing 707s.

The planes, for use on the North Atlantic route, will be powered by Rolls-Royce engines, Boeing pur says.

Harold Wilson, Transport and Civil Aviation Minister, made the announcement in the House of Commons.

The planes will cost about \$12,000,000, of which more than two-thirds will be in dollars.

In a month's time, the first plane for Capital, the airline reports to build, even in the period and finish the year at the \$7,000,000 rate registered in the first nine months.

Capital's hopes for future profits are based on the Vacuums, and figures for the first eight months of the year tend to support the carrier's faith in its long-range transport.

Capital reports that in the first eight months its fleet of 23 DC-3s operated at a 52,000,000 mile the 14 Constellation and 12 Constellation at 121,000,000 and 1,300,000. In the same period, Capital's own Vacuums fleet contributed an operating profit of \$2,310,000 to help offset losses from the other carrier's transports.

Transatlantic Traffic Increases

New York—Scheduled traffic over the North Atlantic from August and September showed a 20% increase on the same months last year, bringing the May-September total increase to about 16% over 1955. This upward trend in traffic is being reflected in the carrier's (AW Sept. 3, p. 46).

The transatlantic airline carried 911,990 passengers during August and September 1956 to meet the needs for a 4,000,000. Last May-September the carrier was 3,000,000 passengers.

Good load factors during the last two months reduced the airline's need for capacity expansion in the period. Seats available during the first nine months of 1956 were 6,000,000. Seats for the period were 6,000,000. Seats for the period were 6,000,000.

Month by month, the 1956 transatlantic traffic developed as follows:

- Embarked May 30,000 August 42,000; 51,000 August 31,000 September 73,000.
- Westbound May 27,000 June 32,000, July 43,000 August 65,000 September 66,000.
- Both directions May 61,000 June 94,000 July 94,000 August 97,000, September 94,000.

This increase in traffic of the

western traffic increased sharply over last summer's distribution.

• Last year's passengers carried 197,000 westbound, 186,000 eastbound—a difference of about 5%. This year, westbound total was 231,000 passengers, eastbound was 189,000, a 20% spread in favor of the westbound market.

• During the 1956 season, westbound first-class passengers total showed an increase, from 1,000 to 1,100, over 1955. Last year's first-class passengers were 1,000. Second-class passengers were 1,000. Third-class passengers were 1,000.

Month by month, the 1956 transatlantic traffic developed as follows:

• Embarked May 30,000 August 42,000; 51,000 August 31,000 September 73,000.
- Westbound May 27,000 June 32,000, July 43,000 August 65,000 September 66,000.
- Both directions May 61,000 June 94,000 July 94,000 August 97,000, September 94,000.

Airlines, most of them offering a variety of fares, are now offering the International Air Transport Association 15-day excursion fares which will be in effect Oct. 1 (AW Oct. 22, p. 9), are working their October traffic statistics close to gauge the retail effect of the plan in evaluating the air travel demand for the month.

The airlines, which had old excursion rates effective Nov. 1 through Mar. 31, had dropped off 70,000 passengers in September to 90,000 in October. The 15-day excursion fare is a good all-year round, and the airlines, who have increased the fare, plan to raise Nov. 1 through Mar. 31 though not to compare with the excursion fare.

Jet Age Study Group Organized by ICAO

Montreal—International Civil Aviation Organization last week announced the formation of a study group jet age study to study air navigation requirements for jet transport operations.

The panel's study will include some attention for existing aircraft and will be a study of the requirements for jet transport operations without restricting aircraft schedule patterns.

The task force will also consider ways of meeting air navigation requirements for jet transport operations, such as the need to provide necessary new facilities. Task force members are:

Col. Len de Azevedo, director of civil aviation, Spain; Col. Charles G. Smith, director of civil aviation, Netherlands; Jerome Lindner, managing director of the Flight Safety Foundation, U.S.; H. S. Brown, director of civil aviation, Canada; and Air Vice Marshal Sir Victor Tait, chairman, International Airports, United Kingdom.

R3Y-1 Makes Record Seaplane Crossing

San Francisco—Navy's Convair R3Y-1 transport bomber seaplane has made a 10,000-mile to San Francisco crossing in 6 hr 45 min.

Time was more than three hours faster than previous seaplane records of 10 hr, 23 min set in 1948 by the Constellation, but was 34 min slower than flight of 6 hr 11 min made by a United Air Lines DC-7 last year.

The R3Y-1, a four-engine, which is one of three assigned to VR 2 at the Alameda Naval Air Station, averaged 357 mph, with a 71 ft tailwind. The three R3Y-1s and two R3Y-1s delivered to the squadron to replace the Martin bombers have been assigned to the squadron and are being used for training.

Airways Development Plans Keyed to Jets

By L. I. Day

Indianapolis—Civil Aeronautics Administration's Technical Development Center has kept its evaluation and testing program to jet transport operations, with primary emphasis being placed upon arrival and air traffic control development.

The immediate need for improved and expanded means to handle increasing traffic demands, it says (the CAA's three new *Indianapolis* plus) and provide for the development of jet transports and descent, pattern engine traffic was emphasized last week at the Radio Technical Commission for Aeronautics 1956 Fall Assembly at West Coast Airport here.

The RTCA session of TDC facilities coordinated a progress report on its navigation and air traffic control development and the methods used for evaluating the tests. Principal subjects covered included:

- **Air Traffic Simulation.** The TDC dynamic air traffic simulator is a laboratory device combining optical, mechanical and electronic equipment with the human factor as the control of traffic.
- **Air Traffic Control.** Communication equipment is undergoing research and development directed toward the production of a communication system for air traffic control.
- **ATC Radar Beacon System.** has received intensive technical and opera-

tional evaluation tests on equipment furnished by the Navy under contracts sponsored by the Air Navigation Development Board. Insurance work will be conducted during 1957 at New York, Chicago and Washington.

• **Airways Operations.** Indianapolis Center is a laboratory facility to evaluate new ATC equipment and procedures in a realistic environment.

How Simulator Works

The dynamic simulator gives TDC an opportunity to study new procedures and observe human actions in the various operations. The simulator consists of a large movie screen on which is projected a map of the air traffic control area under study. Expenses considerable dots of lights are superimposed on the screen to simulate aircraft.

Each dot is projected by one of 18 movie driven projectors, which normally controlled from outside pilot console governed by a system operator. Operators control the speed and heading of the dots which make simulated rate turn to correspond to the movement of regular aircraft in a traffic pattern. Climb and descent also are simulated at a realistic rate.

The screen display is referred to radio groups observed in another room by air traffic controllers handling the radio and terminal operations. These simulated radar displays are perceived by means of a rotating sweep. Interphones connect

continually with pilot console operators, enabling the controllers in communication with the simulated aircraft and input to stack turnoffs and approaches as though operating under regular conditions.

An important objective of the simulator tests is to develop a system that will accommodate jet transports without the need for procedure or special privileges. It has been determined through similar tests experiments that jet traffic can be handled with greater safety, less controller work and less delay. For all traffic of holding patterns are received from the final approach course, a procedure already in use at several airports.

The simulator has taught Technical Development Center personnel that a two-track landing system is necessary of the airport acceptance rate is to exceed 36 approaches per hour. Furthermore, it has been learned that holding patterns even be sufficient to clear of the final approach to allow room for adjustment of approach altitude and permit aircraft to make one turn into the final approach course without obstruction.

Adequate Distances

Prohibited tables of adequate distances between aircraft at different speeds are recommended for such studies as a result of the simulator tests. Observations also indicated the desirability of grid markings on map outlines as a reference for the controller in judging optimum spacing of aircraft as the final approach path.

The air traffic control coordinating equipment project involves a research and development program for a communication system for collecting, storing, processing and displaying flight information for air controller use. The TDC is producing an experimental program that is being evaluated under simulated conditions and that will be implemented at next development stage demonstrated to be practical.

The program is being conducted in a three phase approach.

Phase One is aimed towards achieving personnel work in collecting and displaying flight information. The Technical Development Center hopes to use or duplicate this effect in the intensive practice of flight program steps (now handwritten) and intensive review of data from one sector to another. Equipment requirements for Phase One include:

- **Teletype writer-transmission system** for collecting flight plans.
- **Flight plan input device** for fast and accurate composition, checking and transmission of flight plans.
- **General purpose computer** that will check accuracy of flight plans, detect



NEW procedures and human reactions can be studied with simulator at center.

flight plan into a series of displaying messages computer extracted and used to appropriate priority.

• **Automatic printer** for reproducing flight program strips on standard form.

Phase Two provides for automatic display and automatic revision of flight data. In addition to equipment needs under Phase One, an electronic device that will display information now caused on flight program strips by projector techniques—or by means of a character or typewriter—will be required.

Phase Three moves into the application of the gross picture information (This provided by radar, assigned data links or identifying techniques.)

System requirements in addition to those of Phase One and Two are:

- **Radar data link.**
- **Assigned data link.**
- **Filtered picture-information display.**
- **Fast-gun computing system.**

Under a project sponsored by the Air Navigation Development Board, a magnetic data message storage and processing unit and automatic flight data displays have been developed consistent with an automatic inter-transport switching center, the program now being evaluated by the Technical Development Center in the application of parts of Phase One and Two of the proposed new information system. Lack of funds, however, has prevented the inclusion of any computing functions.

Using trained operators as a substitute for a general purpose computer with the data and automatic display, as many as 60 aircraft per hour were handled at two sectors of the Indiana pilot area in a simulated operation.

Radar beacon system equipment has

been used by TDC for test purposes have characteristics that are compatible with terminal system requirements but are not considered prototypes.

Consistently of the beacon system is a major advantage since it characterizes the need for aircraft carrying two types of transponders. However, the future is also a major disadvantage since substantial ground equipment now adds cost to ATC display.

Tests of a data link type of display

equipment developed by the Naval Research Laboratory, have been made at TDC which demonstrate that developing equipment can be effective.

The Airways Operations Evaluation Center program is divided into two major efforts at the present time. The first stage is immediate progress in the study and evaluation of a complete new system. The second part involves the evaluation of the automatic system. Both stages of the program will include studies of screen and air space structure and an analysis of rules and regulations.

The center also is analyzing the effects of both striking the weaknesses of high speed aircraft through the use of a compressed air gun that will propel the body of a chicken up to speeds of 2,000 mph.

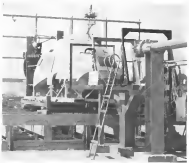
Components of the gun include a compressor and related equipment that provide an air supply of up to a maximum 500 psi, two large tanks for storing air under pressure, a rapid-acting discharge valve, a leading breech and a 4-ft. barrel air under air discharger.

Windshield perch of a Boeing 707 was recently tested against ball values of up to 418 mph. While no penetration of the laminated windshield occurred, some air entry behind the glass was observed.

Similar tests were performed on an Alouette 154 helicopter engine. A chicken body fired into the air inside of the engine at a speed of 300 mph caused no damage to the engine.



AIRWAYS simulates how map of traffic control area projected into large movie screen.



AIR GUN to shoot 4-lb. chicken carcasses at windshield can simulate 2,000 mph speeds.

Airline Income and Expenses—August 1956

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Subsidy	Total Operating Income	Total Operating Expense	Net Operating Income (or loss)
DOMESTIC TRAVEL								
American	\$27,312,291	\$445,544	\$694,571	\$1,407,341		\$29,859,706	\$29,315,442	\$544,264
Boeing	3,454,247	76,849	23,871	105,734		3,659,201	3,579,337	79,864
Capital	3,454,247	76,849	23,871	105,734		3,659,201	3,579,337	79,864
Continental	1,491,441	37,944	11,951	34,614	\$2,745	1,539,891	1,492,970	46,921
Delta	3,932,434	135,457	75,749	157,861		4,241,401	4,198,934	42,467
Eastern	18,225,694	292,704	191,291	249,237		18,958,926	18,811,944	146,982
Northwest	2,734,465	42,383	13,043	41,930		2,831,821	2,818,842	12,979
Northwest	1,142,754	19,517	6,140	18,140	19,399	1,186,950	1,174,910	12,040
Northwest	4,261,274	135,979	81,212	93,554		4,572,019	4,529,945	42,074
Trans World	15,947,544	314,620	224,727	44,321		16,527,212	16,455,440	71,772
United	31,455,121	706,327	484,420	1,644,793		33,286,661	32,844,957	441,704
Western	2,195,149	71,109	33,370	48,464		2,348,192	2,346,345	1,847
INTERNATIONAL								
Aerolineas	461,918	15,242	514	44,464		507,138	493,921	13,217
Boeing	192,434	117,434	25,334	35,334		368,536	355,270	13,266
Can-Am Airlines	178,569	1,820	1,820	6,820		182,929	171,240	11,689
Delta	462,913	5,310	10,344	48,474		527,041	513,710	13,331
Eastern	1,225,432	32,107	17,447	17,447		1,292,436	1,284,761	7,675
Northwest	111,190	2,820	820	3,727		116,557	115,381	1,176
Northwest	1,677,145	444,344	1,444	377,811		2,499,744	2,475,454	24,290
Trans America	844,880	31,800	90,880	111,880		1,078,540	1,068,880	9,660
Alaska	11,845,200	775,880	476,880	115,880		12,213,840	12,180,880	32,960
Boeing	5,394,400	482,880	45,880	45,880		5,969,040	5,915,880	53,160
Latin America	2,861,700	240,880	280,880	317,880		3,681,340	3,638,880	42,460
Passenger	1,244,880	14,340	115,880	115,880		1,587,080	1,571,871	15,209
Trans World	4,935,167	445,133	320,880	445,133		5,746,313	5,671,444	74,869
United	1,269,306	39,814	13,779	13,779		1,336,878	1,345,706	(8,828)
LOGAN SERVICE								
Allegiance	455,485	5,141	10,584	4,764	127,115	613,289	603,421	9,868
Allegiance	144,481	2,810	3,810	100,880		147,981	147,110	871
Capital	183,844	2,107	930	3,337	172,437	360,691	354,372	6,319
Eastern	197,714	315,344	1,110	7,554		396,722	371,444	25,278
Delta	197,714	315,344	1,110	7,554		396,722	371,444	25,278
Delta	461,404	4,767	4,767	7,554	10,760	489,291	471,874	17,417
Northwest	441,344	10,811	10,811	10,811	40,811	503,777	491,344	12,433
Northwest	192,434	192,434	192,434	192,434	192,434	770,166	770,166	0
Passenger	457,021	5,440	4,021	6,907	154,319	627,708	614,400	13,308
Southwest	192,434	7,107	2,204	18,434	333,227	544,405	544,405	0
Trans World	364,791	6,314	3,784	3,071	120,433	498,383	481,428	16,955
United	379,444	14,070	3,800	14,338	114,433	511,085	501,428	9,657
United	311,790	5,494	1,510	5,745	112,344	531,883	528,450	3,433
REVENUE								
Revenue	\$24,849	2,430		\$4,820	\$8,814	\$60,828	\$79,517	\$18,689
Trans Pacific*								
CARGO INCOME								
American	\$11,844	\$1,079	\$1,079	\$1,079	\$1,079	\$11,844	\$11,844	\$0
Boeing	33,180	3,779	7,844	31,437		76,240	72,440	3,800
Capital	33,180	3,779	7,844	31,437		76,240	72,440	3,800
Continental	33,180	3,779	7,844	31,437		76,240	72,440	3,800
Delta	121,234	21,829	474	41,428	31,807	216,772	214,111	2,661
Eastern	744,910	204,127		174,743		1,123,780	1,104,444	19,336
Northwest	379,444	14,070	3,800	14,338	114,433	627,085	614,400	12,685
United	126,181	23,399		20,719	42,344	212,643	204,719	7,924

*Not available
Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.



On Hercules One, equipped with Flight Refueling hose reel unit, transfers fuel to F4U-71 on the ground, allowing one stop transcontinental flight.

NOW! FLIGHT REFUELING FOR HELICOPTERS

How to get helicopters across long stretches of water or far-flung terrain where ground facilities are nonexistent has been successfully and consistently solved by aerial refueling.

Two recent major developments have contributed to the solution of this problem.

Let's begin with the Army's latest H-34 made the first helicopter non-stop transcontinental flight in history. This flight marked the first actual aerial refueling of a helicopter.

In addition, other armed services have successfully conducted extensive aerial refueling between major winged aircraft.

It is typical that the Army's historic transcontinental flight was made possible by a refueling system developed and produced by Flight Refueling, Inc., and that a project to extend the range of Marine Corps helicopters is being undertaken by Flight Refueling, Inc. — the only company in the world devoted exclusively to the development and manufacture of aerial refueling, strake and related components.

New Probe and Design system, pioneered by Flight Refueling, Inc., can be successfully used for helicopter to helicopter refueling as shown in preliminary Marine Corps tests.

ATTENTION ENGINEERS

Helicopter refueling is only one of many fueling projects being undertaken by Flight Refueling, Inc. Many long-range projects present unusual, many approaches for engineering personnel. Write Bill Mendenhall, Engineering Manager, for further details.



Flight Refueling, Inc.

MEMPHIS INTERNATIONAL AIRPORT Memphis 3, Maryland

WEST COAST REPRESENTATIVE

William E. Darr, P.E., Box 442, Englewood, California

DATON REPRESENTATIVE

Robert L. Maynard, 6110 Lowell Ave. Road, Dayton 3, Ohio

MISSILE ENGINEERING



STAYLINE JET (left) is basically a magnet combustion system burning ethylene in high pressure air to produce a 3,500° air blast. Rocket jet (right) injects models to the exhaust of a liquid-propellant rocket and can produce temperatures up to 4,100°.

Heating Studies Tax Apparatus Ingenuity

Langley AFB—Laboratory simulation of aerodynamic heating calls for technical ingenuity almost comparable to that needed to create aircraft which will meet the problem in flight. NACA's Langley Aeronautical Laboratory furnishes several prime examples of the apparatus under its skill.

Some exploratory devices used at Langley are:

- Stagnation model test cells such as reentry heat exchanger tunnels, combustion products tunnels, special compressors, shock tubes, tunnels and nozzles.
- Freezing models, including gas heated

propellers, rocket-burn, models and full scale aircraft.

• Combination of flowing models and static test units. Propellers or models are flown up stream into the test section of high speed tunnels. Among these are the reentry simulators.

As air is expanded through a supersonic nozzle into a high speed tunnel test section where it is substantially cooled greatly reducing the value of aerodynamic heating test runs. Shock heat exchangers have been used to heat up stream temperatures by drawing heat from external burners. Their value has

been limited because they soon reach temperatures approaching the melting points of metals (4,000 to 5,000°).

NACA's ceramic heat exchanger uses air stream temperatures heated to the melting point of metals and in color exchangers. When the air was first conceived scientists were not certain this potential could be fully realized.

High speed air streams develop steep temperature and pressure gradients independently and it was feared these might upset test results.

Butter than ink words of scarce funds



CAST MAGNESIUM fan fan the Nike booster failed due to aerodynamic heating when surface temperatures got high enough in speed runs to melt the leading edge (right). Showing the leading edge for its round shape section without heat transfer, but not enough (center). Clipping the fan with (left) solved the problem for the duration of the hypersonic flight.

on a big project NACA built a small scale model of the ceramic exchanger tunnel to find out if the idea was workable.

This little tunnel can produce a three-quarter inch jet with a velocity of 5,000 fps and a stream temperature of 4,000°. The jet enters a vane cooled so long it flows melting or changing shape in a way that might affect the speed, smoothness, or direction of flow.

Thus about the effect of gradients in the stream heated to maintain and the full scale ceramic heat exchanger is now being built. Velocities of the unit is somewhat unusual because of the unusual size of the heating plant relative to the test section.

Rocket Exhaust

Combustion products towards an essentially rocket jet through the exhaust need to simulate air stream. Though the chemical composition of the combustion products differs from that of air, temperatures, pressures and velocities can be controlled to provide a good simulation in other respects. It is possible to get some measure of combustion effects on the model by using a mixture of fuel and oxidizer which will leave some free oxygen in the stream.

One advantage of the combustion products tunnel is that heat is produced so quickly by the release of chemical energy that heat gases need not be controlled over a very long distance. The result is simplicity and smaller unit size.

One of the combustion products tunnels is the rocket jet. It is a liquid propellant rocket motor with a 12-in. nozzle.

Models used in the test section may be up to one inch in diameter. Maximum stream velocity is about 7,000 fps, and stagnation temperatures up to 4,500° can be produced. Exhaust products are oxygen, nitrogen and water vapor, the major constituents of air. The proportion, of course, differs.

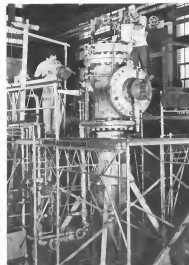
One of the uses of the rocket jet is materials testing. In a demonstration the stagnation temperature on a titanium cone cone was used to 3,000°. In actual flight a speed of Mach 7 at altitude would produce the same heat problem. The cone, heat rate data lines and a distribution of the demonstration because of the unusual effects of heat and high temperatures for winging and design.

Large Nozzle

The ethylene jet at NACA's Wallops Island station has a 12-in. nozzle permitting researchers to use relatively big models. But high pressure air is fed to the jet from the nearby payload jet facility. The burning of



CERAMIC heat exchanger in prototype for larger scale to produce hypersonic high temperature jet of air. Top view (top) has several probes under test in blast through a water-cooled nozzle 2 in. in diameter. Complete unit (bottom) gives impression of size and complexity of apparatus needed to produce only a small test jet. Unit is fixed with ceramic "brakes" to maintain extreme temperatures needed, which exceed the melting point of most metals.



ROCKET POWER



very precisely they called it "the art of rocketry." Today, artificial models of space-related science, rocket propulsion is an engineering discipline in applied technology and in established industry. The applications of rocketry devices are essential, the possibilities are unlimited.



Aeroyt General Corporation needs men of perfect fit, imagination and practical experience. To have Aeroyt offers unlimited opportunity.

Mechanical Engineers
Electronic Engineers
Chemical Engineers
Electrical Engineers
Aeronautical Engineers
Civil Engineers
Metallurgists
Chemists
Physicists
Mathematicians
Technical Editors

Aeroyt General
A Division of
AERODYNAMIC CORPORATION
4400 Wilshire Blvd., Suite 1000
Beverly Hills, California 90210

Write: Director of Scientific and Engineering Personnel, Box 7940, Los Angeles, Calif., 90046, for information.

ethylene is a combustion chamber then gases are atomic temperature yet higher. It is capable of creating stagnation temperatures of about 5,500° and stream speeds of 4,300 ft/s.

Flying models can provide the closest simulation of the real thing but they are expensive and hard to observe. Because of this, flight tests are closely coordinated with tunnel tests.

An example of this occurred when a hydrogen test rocket was fired from Wallops Island to check aerodynamic heating on a specimen area, cone. The first stage was an Honest John motor and the second stage was a Nike booster. The second stage should have reached a speed of Mach 5, but two seconds after it was ignited it veered over from its course and crashed, indicating the failure of a stabilizing fin. Estimated speed at the moment of the crash was about Mach 5. From this it was possible to conclude that aerodynamic heating might have caused the temperature of the magnesium fin to its melting point.

To establish this and find a successful configuration these specimens for use tested in the wind-tunnel. The maximum stream temperature was 1,000° and the elapsed time of each run was 2.5 sec. It was estimated that the wind-tunnel test was the best aspect of the test rocket flight. The first fin was identical to the one which failed, a good vacuum design with a little bit leading edge. A large part of it was burned away, indicating that the cause of the crash had been correctly identified.

The second fin, also of magnesium was redesigned with the leading edge

blunted to a 6 in. radius to provide better heat transfer. Less of it melted, but too much to be acceptable. The third fin was identical in design to the second but the leading edge was capped with a 1/2 in. sheet of metal. This one survived its dosage and was adapted for further flight tests. Coordinated testing such as this has saved the speed limit on NACA flight testing beyond Mach 10.

Turbocraft Organized for Missile Projects

Fuscon, Calif.—Turbocraft Inc. has been organized to provide design, development and consulting services in the field of aircraft and missile rotating machinery, specifically in accessories, turbines and turbo-propellers.

Key engineering personnel are five long-time employees of Aerojet General Corp. who have resigned from Aerojet to form their own company. They are: Thomas A. Carter, Jr., who is vice president and chief engineer of Turbocraft; Robert D. Lutz; John S. Ross, Paul P. Dixon, and Alvin Hagan.

All were employed in Aerojet's Rotating Machinery Dept. Carter was assistant chief of the department. Lutz was supervisor of Test Section. Ross, staff assistant to the department's chief engineer, Dixon, supervisor of Design Section. Hagan, supervisor of Turbine Section.

President and general manager of Turbocraft is Donnie Luedke, formerly marketing manager of Western Gear Corp.'s Electro Products Division, Pomona.



Japanese Rocket

Japanese Kaps 328-B experimental rocket being prepared for flight at Tokyo University's model proving center at Michinoji Beach. Rocket capable of 2,700 lbs. thrust 24,000 ft. during 72 sec. flight time, will be used during Japanese participation in International Geophysical Year.

Heron's Aeolipile

In the 3rd Century B.C., 200 years before Newton, Heron of Alexandria anticipated essential concepts of jet propulsion with his working model of the aeolipile, a steam-driven forerunner of today's rocket engines.

Heron, Newton, Goddard, von Karman... the principle endures, the need evolves, the powerplant is born. In our time, Aeroyt-General Corporation represents the culmination of research, development and manufacturing in rocket propulsion.

Aeroyt-General AERODYNAMIC CORPORATION
A Division of
AERODYNAMIC CORPORATION
4400 Wilshire Blvd., Suite 1000
Beverly Hills, California 90210

Engineers, scientists... if Aeroyt-General your opportunity for creative expression is bounded only by the limits of your imagination.

Only as good

AS THE COURSE IT KEEPS...

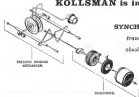
TO CONTROL a guided missile effectively and absolutely is a challenging problem with which thousands of engineers are grappling every day. The solution depends upon the efficiency and the reliability of the controlling parts.

For over 28 years Kollsman has been making precision aircraft instruments and equipment used on military and commercial aircraft throughout the free world.

Kollsman Synchroal Transmitters and Monitors, made to the high standards necessary for use in our own Air Data Computers, are now available to other manufacturers of flight controls and Air Data Computers.

KOLLSMAN is in production on Transmitters and

SYNCHROTEL TRANSMITTERS for the remote electrical transmissive of data such as true airspeed, indicated airspeed, absolute pressure, leg absolute pressure, differential pressure, leg differential pressure, altitude and Mach number.

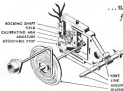


CAREER OPPORTUNITIES

We have openings for mechanical and electromechanical engineers and some technicians. Write us if interested.

Monitors of proven accuracy and reliability for missile control

...now available to other manufacturers of flight controls and Air Data Computers



PRESSURE MONITORS to provide control signals for altitude, absolute and differential pressure, vertical speed, etc.

Enclosures are available at the above prices. PLEASE WRITE US REGARDING YOUR SPECIFIC REQUIREMENTS IN THE FIELD OF MISSILE CONTROL.



kollsman INSTRUMENT CORPORATION

17-01 100 AVE., CLAMNETT, NEW YORK • ELSEVILLE, CALIFORNIA • DIVISION OF *Standard* CELL PRODUCTS CO., INC.

KOLLSMAN PRODUCTS
Flight Instruments
Precision Gyroscopes and Synchroal
Engine Instruments
Speed Systems and Transmitters
Magnetic Instruments
Precision Flight Controls
Motors and Synchroal
Precision Test Instruments (Drift
Analysis and Inducting Laboratory)

For Random Vibration Testing:

CALIDYNE'S NEW COMPLETE, MATCHED SYSTEM



When Calidyne has completed the analysis of building systems subjected to random vibration, it constructs the model of a building system capable of producing random vibration. This model is then used to design a shaker system to produce the random vibration required for the test.

When Calidyne has completed the analysis of building systems subjected to random vibration, it constructs the model of a building system capable of producing random vibration. This model is then used to design a shaker system to produce the random vibration required for the test.



HERE'S the MAN YOU WANT to SEE!

He's the PERMAIDIZING man... your nearby Stillman representative with all the answers to your rubber-to-metal bonding problems. Ask him about PERMAIDIZING, the exclusive Stillman high-quality rubber-to-metal bonding process that provides precise, fast-free parts of optimal smoothness and allows effective sealing at zero-zero pressure. Write or call your nearby Stillman representative today.



Stillman Rubber Co.

5611 Marilyn Ave., Culver City, Calif.
23525 Lorain Rd., Cleveland 26, Ohio

Stillman has the answer...
PERMAIDIZING

which suggests that it is the design element in engine and engine controls. Control engineers in these fields have been constantly plagued by sluggish temperature sensors which lag down the performance of the whole system.

High Speed Sensors

For their high speed pressure sensor, Correll has been using miniature quartz SIM gauges made in Switzerland and distributed in this country by the Kistler Instrument Co., North Tonawanda, N. Y. The signal is sent into his box a problem, but for lack of a better page type Correll has been endeavoring to learn how to live with this device.

The basic system is built around small accelerometers which record the motion of the model as it vibrates on its sponge rubber mounts.

Correll uses high speed Zenith oscilloscope cameras with xenon-type light sources and high voltage optics to illuminate stationary photographic plates built into the "reading" line through the Kistler technique with variously oriented scale edges.

Lockheed Lets Contract For Nuclear Laboratory

Marina, Ga.—Lockheed Aircraft Corp. has contracted for the construction of a \$11 million laboratory at USAF's engine research facility under development on a 10,000 acre tract northwest of Marietta, Ga. General Dynamics-Southwestern Construction Co. of Atlanta.

The laboratory will accommodate 200-100 nuclear scientists and engineers. Lockheed is building the facility and will operate it upon completion for USAF. Previous contracts totaling \$1.2 million provide for roads and other support facilities.

Anacosta Produces Alumina From Clay

The Anacosta Copper Co. plans construction of a \$15 million pilot plant for the extraction of alumina—the raw material for aluminum manufacturing—from Idaho clay.

The company recently announced that test plant experiments with the process have been successful in producing commercial grade alumina. At present the U. S. is dependent on foreign, largely imported from the Caribbean area, as a source for alumina.

The pilot plant will have a capacity of 50 tons per day, and require a year to construct. Anacosta has obtained two licenses of the clay, located in the Macon, Idaho, area, and expects to build a full-scale plant there.

Tellon Has Possible Uses for Missiles

Tellon (tetrafluoroethylene resin) paper and pipe fittings having possible missile applications are now in study at Chevrolet and have no known rival.

They are stocked only by motion study metals and fluorine at high temperatures and pressures, Tellon resin.



retin, including, sulphur, hydro fluorine and hydrochloric acids.

It is unaffected by high oxidizing compounds such as aqua regia and sulphuric or chromic acids and will withstand 150 psi at temperatures ranging from below -20° to 200° F. It has high dielectric strength and low power factor and dielectric constant in a wide range of temperatures and frequencies.

Having inventors, Inc. 900 Glenbrook Rd., Yonkers, N. Y. 10590. Factors the pipes and fittings, which are shown in photo.

Bright Metals Can Insulate Ceramics

Frictions of low temperature metals but hot rods of ceramics can be joined by one of the firm's of a bright metal such as gold as platinum over the first coating of particles coated ceramic.

These anti-oxidizing metals will reflect most of the infrared energy radiated at them by the glowing gases and to help to prevent the ceramic from suffering stresses of thermal shock. The ceramic is themselves in the solid and absorption wave they are not only rough surfaced but usually dark colored.

Platinum over a ceramic coating, for example, would enable a relatively low-temperature metal part to exist in an 1800° Fahrenheit gas stream. The expert might not be in preference as one would expect. In fact of the thickness considered (5 millionths of an inch) it only takes 517 watts of gold to cover 50 sq. ft., according to Robert Langlois, Hydrogen Ceramic Dept., East Newark, N. J.

proving ground for ideas needs

Creative Engineers



A proving ground for ideas is the most apt description for All American Engineering. For over 16 years, AAE has specialized in engineering service to the aviation industry and the military... working at the critical stage between design concept and prototype.

PERFORMING OUT AT ALL AMERICAN



A highly new concept in aircraft design, the "mini-squid".



AAE advanced type portable starting and emergency power supply for the Navy's ships.



During advance concepts — like the Spring subsonic and supersonic-bentched leading craft — have most recently stemmed from AAE drawing boards. At the same time, All American has designed and produced universal leading gear, air-line winches, semi-erect transport, and a wide range of energy storage devices. Engineers, investigate your career at AAE today.

*All American
Engineering Company*

ENGINEERS • ARCHITECTS • PLANNERS



PILOT in strenuous struggle to keep slide projects mounted on slide aligned with red ball at right.

High Speed, Altitude to Alter Pilot Rules

By Russell Howkes

Langley AFB, Va.-pilot techniques will be changed markedly as speeds pass Mach 1 and as unusual light outside the earth's atmosphere becomes a preferable thing. Researcher must forecast problems the pilot will face and seek solutions.

NACA scientists here have built simulators to expose the pilot to as turbulent control problems in the relative safety of the laboratory. One is capable of simulating the longitudinal stability and control problems encountered in any type of aircraft from World War II fighters to modern ball-bast missiles and space craft. It is even capable of subjecting the pilot to some of the G loads encountered in stabilizing satellites caused by attitude disturbances.

Long Oscillations

In oscillations of light at the upper edge of the atmosphere the pilot finds that the period of oscillations cannot be attitude changes is much longer than those at lower altitudes. Damping effect is small because of low dynamic forces on the airplane surfaces. For the same reason effectiveness of con-

trol surfaces in flight and structure of a disturbance must be truly large and quickly reversed to avoid long swings to the opposite side of the desired attitude. Because amount of disturbance and recovery time are likely to be large, it is difficult to tell a few paper exercises has been applied.

NACA pilots feel that greater control force, possibly provided by jet streams, would ease the problem considerably. However, committee's reports are not all so rosy.

Space Control

In space, of course, there is no aerodynamic force and no damping at all. Once established they go on indefinitely without some type of positive correction as could be applied by control surfaces.

Attitude oscillations at extreme altitudes can be prevented to some extent by deliberate control handling and the realization that fast corrections are responsible. In this way, it is possible to avoid rotor motion which are great enough to overcome dynamic stability and available control forces. However, this delicate handling is a delicate job and the pilot's attention is easily diverted elsewhere.

Command control systems are being studied by NACA as an answer to this problem. Most in use is NACA's pilot is a system based on a rate gyro. Rate of attitude change produced by the system is proportional to control stick displacement, and the system determines how much control surface movement is needed to hold the desired rate. It would also limit rate to keep rotor motion within controllable limits.

A big advantage of such a system is that it automatically adapts to cope with the rapidly changing control effectiveness and aerodynamic damping that might occur in a steady state atmosphere.

The command control system can also be designed to handle the more complex phenomenon of roll coupling, which actually consists of two types: one caused by inertia forces and the other by aerodynamic forces.

Airplane on Rotor

Inertia roll coupling is gyroscopic precession in which the airplane is the rotor.

Rotation in any direction tends to be translated into the plane parallel to the axis of rotation, the line about

which the weight of the aircraft is centered. Therefore, as the aircraft rolls it turns.

As the aircraft approaches a stable flat spin, force of the precession is critical.

For this reason, inertia roll coupling is more difficult to control at high angles of attack. Deviation of the aircraft is closer to the plane of stable rotation at the outset.

Shorter wings and the concentration of weight in the fuselage at high speed, high altitude aircraft result in a lower rolling moment of inertia and higher pitching and yawing moments than those of past aircraft. This increases the threat of the inertia coupling.

Aerodynamic roll coupling results from high rate of roll. The lateral path of the vertical line in a flat roll can become angled away from the line of flight through enough to create side loads which produce a yaw.

With the command control system the pilot no longer controls surface deflection directly. This being the case, he no longer needs the leverage supplied by a long, front-mounted stick. NACA pilots have been using a long, rear-mounted stick, and later it over the long stick. This report that bar control is obtained by holding it like a handlebar, not because the finger has a better and finer movement than the arm and wrist. It has been suggested that better control might be possible with the stick suspended from above where its pivot would be closer to the wrist and finger joints.

Slave Responses

Along a significant problem in the stability and control situation shows that control surfaces are heavier and responses are slower than in subsonic flight.

Stiffness control problems cause at least high frequency oscillation because they disturb attitude without allowing time for the desired path to change. There is little damping at these speeds and it is impossible for the pilot to correct because the period of the stabilizing oscillation is shorter than his average reaction time. The corrective action may actually cause more plane than the oscillation causing it to diverge.

If the pilot takes his hands off the controls, the heading will gradually be changed in a spiraling direction, however, it is not always possible to leave the airplane to its own devices.

In general, support must be brought to bear on the controls. In a new building, makes the difficult pilot induced oscillations suite it much impossible. Considering the fact that the pilot must concentrate on an external problem rather than the face control handling which can avoid dis-

Checked to your specifications ...Shipped to your schedules



This test stand checks actuating assemblies under simulated operating conditions.



Some of the actuating assemblies now being produced by Ex-Cell-O for aircraft and guided missiles.



Ex-Cell-O produces actuators and assemblies in volume for jet planes and guided missiles.

You can rely on Ex-Cell-O to handle your precision production and assembly work on schedule, to lend you any assistance required to solve your individual problems. For information or a quotation, write, phone or wire the Precision Products Division of Ex-Cell-O.

EX-CELL-O CORPORATION

DETROIT 22, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • CHROME PLATING • CUTTING TOOLS • RAILROAD PINS AND RIVETS • BRASS AND STEEL RINGS • AIRCRAFT AND MISSILE PARTS • NIGHT EQUIPMENT

however, it is apparent that the more bits of bits will be required.

Stability augmentation systems have been developed with good sensitivity and short enough reaction time to cope with the short ground reaction times. One is used by NACA to no position with its command control system.

The stability and control simulator at Langley consists of a cockpit section mounted on a high speed elevator in a two-story, half-cylindrical shaft. The cockpit is set on hinges so that its pitch angle can be controlled by the pilot. A sensitive angle transducer the cockpit is forced. A ramping angle transducer of the shaft. The half-cylindrical shaft is a light blue screen on which a cross-hair is projected from the cockpit section. A red ball on a wire provides a target which can be moved or locked by the operator on the floor or programmed to give a ramping rate of relative altitude change similar to the apparent variation caused in a given run in change with the target.

When entering a new point, speed, and position is to start with simulation of a World War II fighter advance to a high altitude type at an altitude of perhaps 50,000 ft and then to a target in the outer edge of the atmosphere. Guiding against the elevator stage is the possible for failure.

As of the program has not been set up and the cross-hair and target readings to a given position is not leading. With a constant and more direct visible change in relative altitude the problem is essentially

that of firing formation without visual reference to anything but the lead plane. A change in altitude produces the same visual effect as a change in relative altitude.

A system control is an apparent single solution to the problem of control outside the atmosphere but it has problems. One is how best to model the threat of the jet itself. NACA has built similar systems similar to provide a first-hand look. This call it "the sea coast," which is what it is—two 1-beams raised and balanced upon a fulcrum. The pilot's seat is on one beam and the other three Gs and power is supplied in compressed nitrogen. The sea coast can be controlled about all these areas.

Red Life Jackets For Crews Are Shown

Ballistic red life jackets for the exclusive use of crew members of the water passenger flight are demonstrated in Air Command Division of The General Corporation. Purpose is to demonstrate each item passenger, allowing the former greater effective use in helping passengers through safe ditching procedures and into life rafts. The ballistic life rafts will also help minimize the damage themselves especially among the life raft because of the pilot's distribution of weight has led to plans for providing all future Air Command life rafts with color-coded markings at boarding stations.



Wanted:

Design and Development Engineers

Many new men like the McDonnell and Voodoo shown on the facing page—men equipped with Honeywell Autopilot and other Honeywell control systems. And Honeywell's control system development programs call for many more such advanced systems to be produced.

Design teams now being formed offer exceptionally exciting career to control engineers capable of designing computer control systems for...

- INERTIAL GUIDANCE
- FLIGHT CONTROL SYSTEMS
- LIQUID MEASUREMENT SYSTEMS
- VERTICAL RATE AND INTEGRATING SYSTEMS
- DIGITAL COMPUTERS

At Honeywell you'll find top men and top group. Designers, engineers, model makers and maintenance engineers entered in the project will look to you for technical assistance.

An expanding degree of responsibility plus personal experience with actual control systems is required.

Consider these advantages:

- **Monopoles, the top of labor and profit, after you completed our living in a suburban neighborhood by commuting.**
- **Talent and money represent paid.**
- **You can advance, increase position, transfer plant and technical facilities.**
- **Honeywell's leader in control systems, is a sound diversified growth company, annually expanding, the offer personal opportunity to you.**

Write to us:

If you are concerned in a career at Honeywell, send us your resume to Room 2, West Technical Division, Dept. T-1, 1101 Service Boulevard M.E., Minneapolis, Minn. 55455.

Honeywell
AERONAUTICAL DIVISION



McDonnell's two top "Voodoo" fighters fly with Honeywell Autopilots. The classified F-101B

(sister ship to the F-101A shown) has the new

Honeywell MB-5 Autopilot, which does more

for the pilot than any other flight control system

ever designed. A primary feature of this

autopilot is a universal coupler for automatic

ground control intercept, for instrument landing,

and fire control. The MB-5 is another

example of Honeywell Aero leadership in high

performance control systems.



Dornier ASW Helicopter Model

Model of Dornier ASW helicopter designed for Royal Canadian Navy coast guard was displayed publicly for first time at recent show, sponsored by New England chapter of the American Helicopter Society in Danvers, Conn. Three General Electric T55 turbine engines are to be carried on top of fuselage behind the cockpit. Tail wings are top of the fuselage and the main rotor blades fold in to store storage aboard carrier. Gross weight will be about 17,000 lb. Retardable landing gear ASW requires use in landing.



THREE DRAGONS on the ground at Svalöv Airbase today are prototypes for quantity production now starting in Sweden.

Swedish "Double-Delta" Design Goes Into Production

The Swedish air force's Dragon—a successor, all-weather interceptor of unusual "double-delta" configuration—is in quantity production at the Saab Aircraft Co., Linköping, Sweden.

Gross weight of the J35 Dragon is under 10,000 lb., fully loaded and ready to fight. Powerplant is a Rolls-Royce Avon, presently the afterburning RA 25 rated at 10,000 lb. without afterburner.

A Swedish Air Staff spokesman has said the J35 can attain speeds well above Mach 1. Wingspan of the plane is about 35 ft., and length is about 50 ft. For comparison, the wingspan of Convair's F-102A is about 38 ft., and its length is about 65 ft.

First prototype flew about one year ago, and three prototypes are now flying. A fourth aircraft was built in the experimental program for this test.

The Dragon was developed in an air force requirement outlined in 1949 "to intercept enemy bombers in the transonic speed range." Sweden's problem took on a more localized nature because of the airport situation; any interceptor would have to have high rate of climb and be able to operate out of the relatively small fields available.

Supersonic speed in level flight was another requirement and the reason that Saab engineers under Arvid

von Chief Engineer Edl. Bratt started with the delta layout.

Their first approach planned a delta wing aircraft of low aspect ratio, which would have the necessary low drag with an airframe big enough to carry the fuel and weapons load required on the mission.

But they found flaws in their design, connected with the center of gravity location. To get it aerodynamically correct, they felt the fuselage had to be lengthened, and then the air plane would be longer and heavier than necessary.

Somebody suggested the "double-delta" layout at that point, and it appeared to offer the solution. The area



FLYING DRAGONS show sleek aerodynamic layout, made possible, should be an leading spine has been added since prototype.

distribution of the wing could be adjusted to give an optimum position of both aerodynamic center and center of gravity. It looked like the final answer.

All that remained was the proof testing.

The double-delta layout was checked up in wind tunnels and with the Saab 210, a two-seater aircraft with the general aerodynamic form of the J35, then in the design stage. The 210 design began in the summer of 1950 by a team which later became the nucleus of the 508 group responsible for using through the J35.

The wind tunnel work was supplemented by control-line models, down



WING FENCES on J35 design are a two ahead of the others and on under wing intake only.



SAAB 210 research plane was developed as aerodynamic test vehicle. Pilot (right) indicates use of later, longer nose wheel.



REAR PROTOTYPE on ground shows basic simplicity of the low-low aircraft which will cross streams during next few years.

specify LEWIS
high temperature and
moisture resistant
aircraft electrical cable
for critical circuits

to USAF specification 32459



FOR DELIVER SERVICE, WE APPLY
 PL 322 STRAINLESS STEEL
 SHEATH FOR MAXIMUM
 PROTECTION

Standard in U.S. & 20 other foreign countries

For permanent installations specify **LEWIS**
MIL-W-5506A COPPER-CONSTANTAN
MIL-W-5846A CHROMEL-ALUMEL
MIL-W-5845A IRON-CONSTANTAN

IN ALL CLASSES AND TYPES FROM OUR OWN WIRE MILL
 WRITE FOR CATALOG #33

the LEWIS ENGINEERING COMPANY
 new hampshire, connecticut



field engineers
 (RADAR AIR NAVIGATION SYSTEMS)

job requires:

Three or more years experience
 with radar and/or electronic navigation systems.
 Freshness to learn (domestic companies likely find pool).

job offers:

Outstanding pay, pension and benefits
 On-the-job training, excellent work conditions, dynamic organization
 One fine advantage that most advanced electronic facilities.

EXPLORE THIS OPPORTUNITY

Qualified engineers recruited to telephone inquiry. If you are 35-50
 or more, you are in the field of electronics, experienced in radar
 systems, you can be employed at any time, including weekends.



GENERAL PRECISION LABORATORY
 INCORPORATED
 63 Bedford Road, Plainville, New York

A SUBSIDIARY OF



to get a qualitative approach to some of the problems of flight. Such a team was formed, developed at speed to look up the J15 program, began test work in the spring of 1952.

Other models of the J15 were flown into water covered with aluminum powder to study the flow behind the plane. This visual flow technique gives photographic evidence of the flow patterns in the wake.

But much more than barrel work was required. The J15 was the first Saab supersonic design, and it meant much theoretical work.

Special rooms were established in supersonic theory to give the engineering team, with three new hires, Compton, both of Saab and the government-owned unit in Stockholm, were added and are still used for its research in the analysis.

Other tests also included a course to learn birds at supersonic speed against the windfield of a runway, special hydraulic system and fuel system test rig and a static test rig using more than 5,000 stress pins.

**Soviets Plan 100-lb.,
 20-24-in. Satellite**

Designs for the USSR's first artificial satellite—scheduled for launching next year—call for a hollow aluminum sphere, not over 20-24 in. in diameter and weighing about 100 lb., according to a leading Russian observer.

Dr. Georgi Pokrovsky, writing in Moscow News, says that such a satellite may be launched on its course from a rocket at a height ranging from 155 to 810 mi. He adds:

"To revolve around the earth, the artificial satellite must have an initial speed of 5 miles per second. This speed can be achieved by multi-stage rockets. According to one of the designs the rocket will consist of three sections. The first takes the artificial satellite to an altitude of 50 mi., the second to an altitude of 100 mi., and, finally, the third gives it sufficient speed to begin revolution around the orbit of the earth.

"According to some of the calculations, this rocket must weigh about 150 tons, which is approximately ten times greater than the largest existing rocket. Other calculations put its weight at a lower figure. It could be launched with the help of a rocket engine mounted on an airplane.

"Enormous technical difficulties have to be overcome to create artificial satellites. For instance, to achieve the speed of 5 mps, the rocket must have a first tank weighing more, more times the weight of the rocket itself. In modern rockets, the weight of fuel is only 75-80% of the overall weight."



S-58 Shows its Maneuverability

Representative Sikorsky S-58, before all satellite production line for CIA certification testing performed at a recent show sponsored by the New England Region of the American Helicopter Society at Danbury, Conn. Above, the S-58 pulls up to its high altitude. Right was Frank Tweed of Sikorsky test staff. Aron Vogel 1938 is parked on ground, and Night representative aircraft loaded in background (lower left).



Low altitude maneuvers began by S-58 (left).



In near vertical nose high attitude (center), nose starts to fall off toward the left.



Recovery completed S-58 crash (lower left).



In 90-deg bank, S-58 turns back to crowd.



Low altitude maneuvers began by S-58 (left).



HARD WORK IN ICELAND—Supporting an aerial survey team in Iceland, the Sikorsky H-19 of the U.S. Air Force carried personnel and supplies between ship and shore bases. In 20 flying hours, the helicopter carried 44 people

and 47,000 pounds of cargo. This is a good example of how rugged Sikorsky helicopters can operate from very small areas, with minimum support facilities, and under a variety of weather conditions.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS



FIRST S-58 TO BELGIUM—The first units of a fleet of 12-passenger Sikorsky S-58s have been delivered to Selsena, Belgium. World Airways, Selsena, will operate the fleet on its European route. Larger and more powerful than the 800e Selsena now flies, the S-58C, named the Continental, cruises at 180 miles per hour.



1000th S-65—B. L. Whalen, general manager, and Igor Sikorsky, engineering manager, mark a milestone in production of transport helicopters with completion of the 1000th Sikorsky S-65, a Marine Corps RH8. Two larger and more powerful helicopters are also in production, the S-58 and the twin-engine S-59.



HELICOPTER HISTORY



H-34 SPEED RECORDS

In July, 1955, an Army Sikorsky H-34, flown by Capt. Claude Hargett, right, and Capt. Edna R. R. of Fort Rucker, Ala., established new closed-circuit speed records. The records were for 200 km, 142.9 mph; for 500 km, 136 mph; and for 1000 km, 132.6 mph. The previous 1000 km closed-circuit world speed record for a helicopter, 95.6 mph, was set by a Sikorsky H-34 in 1948.

AIRLIFT DEMONSTRATION—To show evacuation techniques in the removal and transport of light aircraft, an Army Sikorsky H-34 helicopter carries a Cessna 1-19. The demonstration and the suspension arrangement were worked out at Fort Sill, Oklahoma, site of the Army's H-34 operations school. The Sikorsky H-34, the Army's newest helicopter in operational use, can carry cargo loads of up to two tons or 17 combat-ready soldiers plus crew of two.



SIKORSKY AIRCRAFT

BRIDGEPORT, CONNECTICUT
One of the Divisions of General Aircraft Corporation



MORE THAN MUSCLE



The airplane changes rapidly, and product requirements with it, but man remains much the same. Today it requires more than muscle to bridge this ever-widening gap between "Century-Series" aircraft and evolving arms.

At G.M. Giannini & Co., Inc. over 30 different types of engineers are combining technological skill with scientific knowledge to help bridge this gap.

Let this experience work for you by calling in your Giannini field engineer. You will gain from his ability and learn the Company's decade of experience in solving instrumentation problems for major aerospace manufacturers.

When accurate, reliable instruments and controls are demanded, specify Giannini precision-crafted products... products which are covered with more than muscle.

General equipment North American F-100 undergoing usual flight prior to take-off.



Engineering positions are open at several Giannini locations for career-minded young men—write for details.

G. M. GIANNINI & COMPANY, INC. • 910 EAST GREEN STREET • PASADENA, CALIF.

AVIONICS

West Coast Survey Stirs Avionic Moves

By Philip J. Klein

At least 15 Eastern and Midwestern electronic component manufacturers are expected to set up West Coast engineering-manufacturing facilities as a direct result of a recent survey which revealed that Southern California's defense electronics industry is disoriented over its relations with its Eastern Midwestern vendors.

Failure to provide adequate engineering liaison, excessive delivery time, and transportation loads were the principal complaints leveled at foreign suppliers in the survey, conducted by the Los Angeles Chapter of Committee for Los Angeles Area Equipment Users (CLAEU).

Research Ideas

The survey also projects the type of components that need more research and development effort, in the opinion of Southern California equipment manufacturers.

The survey results are based on returns from 146 companies, representing 29% of those in the area and whose gross sales represent more than 90% of the area total.

The survey results constitute both a warning and notice of opportunity for component manufacturers. For example, it:

- Disclosed that 85 Eastern Midwestern firms could improve their sales and service to the local industry, by locating an engineering-manufacturing facility in the Southern California area. (The survey report does not list the companies, but Los Angeles area industry firms are vowing each of 85 to discuss the survey results. Vow to date have led 15 firms to contact themselves to set up West Coast operations.)
- Urges better engineering liaison by using field/sales engineers instead of using technical salesmen.
- Reports that off-the-shelf components generally fail to meet the quality and environmental standards needed for advanced military systems.

When asked which "imported" components had the price edge and the approximate price differential, the greatest price differential existed for a. wirewound (300-200%), beam tubing (100%), RF coils (50-75%) and solid state rectifiers (50%).

When asked whether design engineering and design liaison between com-

ponents which had to be maintained to compensate for transportation delays, and because of inadequate vendor engineering liaison. The 1974 survey was made with the view to exposing critical areas and encouraging local industry to fill the gaps where possible.

The spring the Chamber decided to re-survey the situation. It formed an Electronics Development Committee, with key industry representatives, headed by Gen. Harsh L. George (USAF Ret.), former general manager of Hughes Aircraft Co.

Excessive Delivery Time

In its survey, Los Angeles area equipment manufacturers were asked for details on their critical components—those posing quality, price, and/or delivery problems. A breakdown shows that approximately 50% of the critical items listed is imported from Eastern Midwestern sources, the balance is bought locally.

When asked the following questions on each of 54 different types of critical components in use, entirely the response was as shown:

- Is delivery time excessive? 100% "Yes," 0% "No."
- Are transportation costs excessive? 12% "Yes," 88% "No."
- Is engineering liaison inadequate? 16% "Yes," 84% "No."

A breakdown of the distribution channels revealed indicates that approximately 75% of the critical components are purchased through manufacturers' representatives, 10% are bought direct from the manufacturers, another 10% through jobbers and the remaining 5% through wholesalers.

Price Differential

The survey asked Los Angeles equipment makers whether any components purchased from Eastern and Midwestern manufacturers were priced lower than comparable components made locally, despite possible transportation costs.

To this question, 55% replied "yes," 35% replied "no" and 10% declined comment.

The survey asked which "imported" components had the price edge and the approximate price differential. The greatest price differential existed for a. wirewound (300-200%), beam tubing (100%), RF coils (50-75%) and solid state rectifiers (50%).

When asked whether design engineering and design liaison between com-

ponent and equipment manufacturer was becoming more important, 94% answered in the affirmative.

Nonetheless, components are fast becoming the rule rather than the exception, as the result of increasing environmental requirements for new weapon systems, the survey report indicates.

A number of those surveyed recognized the view that component makers are not keeping abreast of equipment requirements and are failing to anticipate future requirements.

However, a significant number of respondents indicated that the equipment manufacturers' engineers will work more closely with component makers to give them as much technical data as is available so their progress requirements, and expedite the efforts to satisfy the component maker when new problems or requirements arise in their programs.

The survey report notes that "improving the liaison between the Eastern vendor and the local manufacturer is a major problem. Many Eastern firms have helped this situation by establishing an engineering facility in the area or by making very closely with local organizations. Local manufacturing of components by Eastern vendors who have engaged the services of a local firm for possible re-design and engineering on a contract basis seems to be increasing in popularity."

Where R & D Is Needed

When asked which components are most in need of R & D effort to meet environmental requirements, the survey replies indicated the following, in order of frequency listed:

- Relay-solenoid-type, thermal time delay, stepping sequence, telephone.
- Silicon transistors.
- Gas-discharge tubes suitable for high ambient temperature use.
- Switches — micro mechanical, rotary, micro, stepping, snap action, limit.
- Condensators — miniature, polyester type.
- Vacuum tubes — micro-miniature shock resistant, high plate dissipation types.
- Servo motors.
- High temperature wire.
- Photo cells.
- Electrolytic capacitors.

Copies of the survey report on electronic components can be obtained by writing to the Industrial Dept., Chamber of Commerce, 464 South Bond St., Los Angeles 54, Calif.



CRANE Aviator Fliteguy, tested in 1952, condenses sides of many instruments (shown around experimental seat, left) in single display.

Early Forerunners of New USAF Instrument Display Disclosed

Following publication of the first of two articles in the USAF's new integrated panel instrument program (AW Feb. 13, p. 67), Norman Weiss received several letters from readers pointing out that portions of the new USAF panel showed a marked resemblance to the Vanevor Fliteguy, designed and patented in 1950 by Col. Carl J. Crane (Ret.). Crane is a former director of the Wright Air Development Center's old Instrument and Navigation Laboratory. Crane's comments, selected by Aerospace Week, follow.

"Through the years there have been many attempts and efforts to clarify, integrate, instrument indications for the purpose of space saving in the late twenties, as a result of my experience with the late Col. W. G. O'Brien (the pioneer in cockpit air display flight) I approached the problem from the human engineering point of view. I sought the transposition of the instrument in space into the cockpit."

"The Aviator Fliteguy is the only instrument (as far as I am aware) that presents in a single panel form the visual structure of flight about the three principal axes and merges them with electronic instruments for the several purposes of heading, altitude, turn and rate of turn. (See photo and sketch, above.)"

"Even in the case evolution of the Air Force you will find an integrative side and winged out, presented in the natural manner as a head, and pilot."

"The Fliteguy design is an integrated unit in a space suit, but orders in a life size. In this I mean in concept it is a head, head, wings, on the visual need of supplying all pilots (beginning with the pioneer student) professional and private with a light reference that exhibits various attitudes of the air and conditions human actions established in learning to fly and reduces to the visual weather when the time required to respond

to the visual stimuli which guide the pilot in effecting a safe and effective approach landing."

"That is, the Fliteguy is now sponsoring a development in which I have spent 10 years in effort to meet considerable things, all which will soon show some benefit from the effort."

Carl J. Crane
Holt, Tex.

Editor's Note: The USAF's All Weather Section light tested an experimental model of the Crane Fliteguy in a F-25 in 1951. It spent in those tests, while using certain shortcomings of the model tested, one stated:

"It is an instrument incorporating the desirable features of the one and merges



SPERRY Flight Key, developed and tested in 1950, condensed number of instrument functions, and outline key table.

using the suggested improvements, as well as covering all the other instrument requirements could be provided for test, it is recommended that such an instrument be designed a complete evaluation on a similar basis before institution as an aircraft."

A short series of tests conducted by the Civil Aeronautics Administration in 1951 resulted in a similar report which found merit in the Fliteguy, but the recommended design was modified.

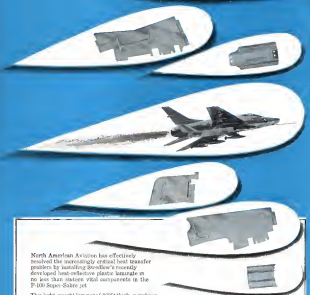
WADC officials at the time, however, were originally intended for the two articles in the new instrument program made no claim that the panel layout or display technique had suggested to WADC. They felt that control that the new instrument concepts have a long possibility and incorporate the ideas of some people. If there is one case which WADC might want to claim as one, although not directly produced, it is that new instruments can be conceived and designed in a single group as a whole panel to present a single display, integrate in their design the integrated nature of the ship between the instrument indications and their respective data sources which are the underlying developing in a result of laboratory WADC laboratory.

And so further proof, if needed, that most of today's aircraft also have their roots in the past. Aerospace Week refers the reader to the Space Flight Flyer, describing a multiple instrument indication as a tribute to the whole system. Also, we are indebted to 1950 and light tested through 1955, the Flight Key displayed heading, altitude, speed, turn and rate of turn, turn and bank, and modes become reference too.

Satellite to Utilize Small, Light Inverter

Manufactured (manufactured) inverter, capable of supplying 500 v-a of three-phase 400 cps power and which weighs only one third as much and occupies only one quarter as much space as a conventional rotating in-

Swedlow HEAT-REFLECTIVE PLASTICS IN NORTH AMERICAN AVIATION'S F-100



North American Aviation has effectively resolved the increasingly critical heat transfer problem by installing Swedlow's recently developed heat-reflective plastic laminate in no less than sixteen VMA components in the F-100 Super-Sabre jet.

This light-weight laminate (0.003" thick, weighing .330 pounds per square foot) shows a temperature drop from 150°F on one face to 50°F on the other face after prolonged exposure.

Most important, it is light in weight and can be easily modified to any shape. If you have a heat transfer problem, investigate Swedlow heat-reflective laminates.

Swedlow PLASTICS CO.

LOS ANGELES, CALIFORNIA

YOUNGSTOWN, OHIO

BUSINESS FLYING



PYRA COMANCHE will be produced in two models, one with 160 hp engine as in prototype, the other with 130 hp engine.

Piper Expands Line to Meet Sales Goal

By Edwin J. Ballman

Lock Haven, Pa.—Target of \$35 million in retail sales of business and utility aircraft in 1977 was just before Piper Aircraft Corp. distributors and dealers during their 10th annual meet-
ing here last week.

Next year's sales goal does not take into account Piper's new longplane FA-24 Commander, which the company will start delivering to distributors sometime next April, sales manager J. W. (Jack) Miller told *Aircraft News*. He also revealed that the company is developing two basic models of the FA-24. They will be

*Comanche-160, powered by a 160-hp Continental C760, and priced at approximately \$13,400. Delivery begins next year.

• **Cummins-250** powered by a 250 hp Isveco G490, which will be available in 1995 with a price tag of about \$16,900.

The latter model is one that Pops hasn't talked about before. The company recognizes few problems in adapting the basic Corvair-150 airframe to the most powerful engine, a production Corvair-150 will be modified next year as a tribute for the 1958 airplane.

Screened Prototype

The 1957 Conquest has over 180 hr of flight test time, a second prototype has been awaiting delivery of some equipment and is scheduled to start flying this month. Some changes are noticeable on the second prototype; for example, the nose has been extended approximately five inches to allow for a new fuel tank in the section. This was necessary when Pratt

enclosed from rubber sheet, absorbs to the one-control-and-one-type. The system hasn't resulted in drastic change in the airplane's balance and the longer nose probably will improve the airplane's takeoff. Under transformation is an electrical actuation system for the landing gear. Evaluation of equipment needed has indicated that the motor actuating an automobile seat movement could be readily adapted.

The 1987 and 1988 Camaro's will be offered in three models as the rest of the Pacer line is Standard Custom and Super Custom. The differences are in the equipment installed. The suppliers will have provision for three sizes.

Paper isn't decreasing detailed specifications and performance by-and-by, says that the Comanche will out-perform any airplane in its price class. Company officials frankly admit that the 1957 Comanche is aimed at meeting the competition it has been getting from Cessna's 180 and 182.

A well-tended line has become a necessity in building sites where space counts out for example, that place of introductions, courtyards, to mention a few. To Pirelli has become a way of life. The company has found it is extending its operations and needs higher performance. Since Pirelli had nothing new achieved in the single-engine drive to offer has been won by a 180 or 190. Parallel situations are experienced by most of the business and utility plant builders, and have been the reason for the quest in new designs and a wide range of types ending up the manufacturers' roster in recent years.

It is too early to measure the im-

part of the new Committee on the company's future dollar volume, Piper says.

It is not yet taking orders from its distributors, although indications are that they have a large number of buyers committed to taking the first 100 hp PA-24 available, after demonstrations are delivered.

Standard 1997 Liec

Promotion of the Comstock product will begin before the end of the year, but with deliveries to customers some months away. Pope's distributors will be showing and selling the company's line of Apache light beers, Tin Beers and Super Cols. Unit sales are expected to increase some over 1956, but not greatly.

In the sales (one year) past, the factors delivered 3,279 airplanes with a total value of approximately \$10 million. This was approximately \$1 million over the quota set by the sales department at last year's meeting. Export sales are about 16%, or 1% over the previous year. Sport parts valued at about \$1.5 million were delivered by the factors.

The 1977 Apache is similar to the previous model with some technical improvements such as addition of a two light on the nose gear in standard equipment and a revision in the starter wiring system that reduces low voltage losses and improves cold weather starts. Higher capacity carburetor jets on basic have installed and carburetors on temperature gauges are standard equipment. Throttle, propeller and mixture control can be positioned quickly in desired settings using push and pull action on the mixture valve.

generally more than one thousand five

A Piper test pilot noted that the change he liked most was removal of the engine starting system. It now consists of a handle switch located on the upper left section of the panel. Formerly two buttons were located for this purpose on the lower left side. Additional soundproofing has been added to the 1957 Apache plus a rubber-backed floor mat to lower cabin noise levels.

Exterior Changes

Most noticeable revenue change is the new standard color schemes. Daytime White takes top to reflect sun and long cold temperatures down, black nose and engine nacelles to reduce drag, and a choice of Passions Red, Cadillac Red or Key West Blue for fuselage and wings with black, and white trim. Starline paint is offered for the 1977 T-100.

About 670 Apache teens have left Lock Haven since then. In the past year they accumulated 50 million air miles including 24 transatlantic flights.

All 1957 Figures show higher prices, due to increased material, labor and equipment costs although compare affords us that some of the increases have been absorbed through greater efficiencies in production.

The three 1957 Apache ranch carry these price tags (1996 prices in parentheses): Starland, \$34,900 (\$34,000), Canyon, \$37,750 (\$35,750) and the Soree Canyon, \$39,990 (\$37,840).

The new T-Series are very similar to last year's models, most noticeable exterior change is addition of a small running board step on the right side, give to facilitate cabin access. Prices of the new models Standard, \$7,850 (\$7,295); Custom, \$8,480 (\$7,995) and the Super Custom, \$9,450 (\$8,995). Approximately 6,000 T-Series are now in service, the company reports, and they are each averaging about 550 miles hours annually.

The Super Cub and PA16 A tandem tricycles are quite different from personal vehicles. Prices that start for the PA-15 '85 Standard, \$5,395 (\$4,795), the Luxe, \$5,950 (\$5,415), Standard PA-15, 130" wheel base, \$6,085 (\$5,995), the De Luxe, \$7,820 (\$6,120). Agricultural PA16 A Standard model will cost \$6,780 (\$6,145), the De Luxe, \$7,295 (\$6,470).

Loose Prose

In response to distributor demand, Paper has developed an aircraft leasing program with International Aircraft Leasing Co., San Francisco. Standard plus costs 48 months with option to buy at the end of the period for 1% of the original price or returning the lease. The purchaser also has the option to buy the plane any time during the

course of the agreement by paying the balance of the lease less the income received on insurance plus 1% of the explorer's original value. The lease program, which covers the Apache and Ta-Pan, has monthly payments that are consistently in line throughout the leasing period.

At its annual banquet last week, attended by 200 distributors, dealers and equipment suppliers, traditional Paper 'Top Hat' awards for top sales teams were in a down-spiral—there was

stead of the traditional 10 because of two, for fifth and ninth places. Quota buyers received \$15,000 in incentive funds including two-week trips to Germany. Top harvest for 1966

[illegible]

TRI-PACER 150 has 1957 has running board step on right main gear has rubber wheels



NEW COLOR release is used on 1997 Apache. Black rose, monthly subscription.



PIPER SPRAYER is fitted with floating because flat spring back if they strike object

THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

What Can Be Done About It?

There is no easy or quick way to overcome the shortage of scientists and engineers that has become a threat to our national security and economic progress. The solution can come only through diligent efforts extending over several years to bring the supply of technically trained people into balance with our needs. Meanwhile, the pressure of the shortage can be relieved if industry, government and education make better use of the limited number of scientists and engineers now available.

Earlier editorial in this series have discussed the dimensions of the shortage of technical manpower, its meaning for our national security and our economic well-being and the causes of the shortage. This final editorial will survey some of the measures that can be taken to overcome the shortage. Most of the proposals presented here have been suggested elsewhere. But in combination they appear to offer the best hope of an answer to this serious national problem.

Soviet Methods Not For U. S.

It is clear that no crash program, inspired by panic and designed indiscriminately to drive bands of high school students into science and engineering, is suitable for the United States. Even if we adopted Soviet methods of choosing a large portion of our brightest young people into technical fields, it would be at least four years before results appeared in the volume of college graduates. And such an approach would do no credit to the American way of life.

Any crash program, whether it involved totalitarian methods or simply required the abdication of technical careers, would be objectionable for other reasons as well. It would jeopardize the quality of scientific and engineering training. It would put many young people in fields where they have little aptitude and deny them to areas where they are better equipped. And, if carried too far, it might even result in the overcrowding that was feared previously in a few years ago.

The most important problems for the long run, as the preceding editorial in this series indicated, are in the area of education. Any real solution must reduce the loss of talented high school graduates who do not continue their education for financial reasons or because of lack of interest. Also, it must improve the quality of high school preparation in science and mathematics and, above all, relieve the critical shortage of teachers.

Basic Needs in Education

Substantial increases in salaries of teachers in most of the nation's school systems are essential if high school students are to receive adequate preparation for courses in science and engineering. Pay scales that have lagged behind rising living costs and salaries available in industry have placed great stress on even the most devoted teachers. There has been a sharp drop in the number of new graduates trained in both science and mathematics, and of this smaller number many have decided not to follow careers in teaching.

Raising teachers' salaries to more realistic levels must be primarily the job of local school districts, aided by state governments. If, in face of rapid increases in school enrollments, local and state resources prove insufficient, then federal aid will have to be considered. Higher teachers' salaries, however desired, inevitably raise higher taxes. But without appreciable improvement now, the quality of our entire educational system is in danger.

At the college level also, financial aid is needed to provide scholarships for promising students and to increase faculty salaries. (An earlier series of editorials dealt more fully with these problems, and business and higher educational institutions have been discussing at a grinding pace.)

But not all the educational problems related to the shortage of scientists and engineers can be solved with money. Science and mathematics have steadily been de-emphasized in more youngsters have gone to high school for technical education, other

How business is helping to relieve the shortage of technical manpower

Summary of a
Survey by McGraw-Hill Correspondents

- Sponsoring summer study programs for high school students
- Arranging cooperative work-and-study programs for students
- Sponsoring college fellowships and scholarships in science and engineering
- Paying tuition of employees taking science and engineering courses
- Keeping college faculties abreast of new developments in industry
- Hiring high school science teachers for summer and part-time work
- Giving all, but usable, laboratory equipment to schools
- Cooperating in high school science exhibits
- Sponsoring regional science fairs
- Sending speakers and training aids to schools
- Donating books for student loans
- Analyzing jobs to advise engineers and scientists of career work

The McGraw-Hill Department of Economics will be glad to hear of any other ways business is helping relieve the shortage.

than for college preparation. This dreamboat must be revised.

Outcrop of instruction, furthermore, can stand improvement at all levels of education. Frederick E. P. Northing of the University of Chicago observed: "In the past fifty years . . . there has been a revolutionary change in the character of mathematics, yet not a trace of this change is to be found in the majority of all but a handful of secondary schools throughout the country." Colleges and universities may have to examine old textbooks about light teaching loads and small classes in order to make more efficient use of their facilities.

What Industry Can Do

Industry has the immediate problem of better utilization of available technical manpower and the long-range responsibility of helping increase our resources of trained people. Frantic overruling practices and reckless building up of starting salaries—financed largely by government money for defense orders—are not the answer. There is need for earnest re-examination of incentives for experienced scientists and engineers, who too often must look to sales or executive positions for adequate financial recognition.

Industry is sure business could make more efficient use of engineers and scientists by shifting work to technicians, clerical personnel and even machines. One company found that 13% of the time of an engineering design group was spent on routine jobs and that this valuable time could be saved by adding a technician and a clerical worker to the group.

Other potential sources of technical manpower could be tapped more extensively to relieve the shortage. Very few women have entered what has been traditionally a man's world. Negroes are only slowly getting educational and employment opportunities in technical fields. And many experienced older men can still give useful service.

A Good Beginning

Much is being accomplished already in efforts to attract more young people into scientific and engineering careers. A summary of some of the things business is doing is presented above. Other notable contributions are being made by such organizations as the professional engineering and scientific societies (especially through their management committees), the National Science Foundation, the National Research Council, the National Education Association, the National Natural Science Foundation and the Thomas A. Edison Foundation.

Results are beginning to appear in rising enrollments in engineering schools and technical institutes. Between 1950 and last year, according to McGraw-Hill's annual survey of technical institutions, enrollments in these schools rose from 46,000 to a record 67,000. Engineering enrollments rose in the same period from 166,000 to 243,000. A rising tide of graduates is already being made available to American industry.

This is a good beginning. But only with wider appreciation of the serious implications of the shortage of scientists and engineers and intensified efforts on the part of business, government and education to relieve the shortage can we hope to overcome this threat to our national security and economic well-being.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important national developments of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or part of this text.

Donald C. McGraw

President
McGraw-Hill Publishing Company, Inc.

The Reader Is Boss

or...How ABC Helps You Run The Magazine Business

Readers who pay for magazines are always ripe for new ideas, new information, new trends and new technological developments. By giving or withholding their subscription money, reader-consumers vote for or against editors and publishers. Consisting these "votes" is the important job of the Audit Bureau of Circulations—the watchdog of the publishing industry.



YOU CAN TRY which magazines have fully audited paid circulation when you see the ABC symbol on their cover or contents page. This is the symbol that stands for the Audit Bureau of Circulations, a cooperative organization that sets standards of good business conduct for its publisher members.



YOU'RE THE BOSS when you pay money for any magazine. Your vote of confidence and your renewal of subscriptions are decisive in the thinking of editors and publishers. Advertisers are vitally interested, too, and their support helps ensure the dollars needed to do a stronger, more useful editorial job for you.



McGraw-Hill Magazines

McGraw-Hill Publishing Company, Inc.
230 WEST 42nd STREET, NEW YORK 36, N. Y.



ACCURATE FIGURES—ABOUT YOU are the heart of ABC's job. ABC does a careful, unbiased, certified audit of all subscription figures for aviation magazines—not of the subscribers' jobs, functions, and lifestyles. These audits help editors to tailor the contents of their magazine to your specific job interests.



YOU, THE SUBSCRIBER, WIN when you buy ABC magazines, for this mark is your assurance that you are getting a publication tailored to your needs. McGraw-Hill has been a charter member of ABC and has supported its aims continuously for over 40 years. And ABC, in turn, is responsible in many respects for the high standard of business magazine publishing today.

SAFETY

CAB Accident Investigation Report

'Missed Approach' Ruled in Eastern Crash

An O-149, Model 21, 1915, a Lockheed Constellation, serial L-7494, N 112A, owned by Eastern Air Lines Inc., and operated by Flight 642, crashed during its ILS (Instrument Landing System) approach to runway 5, Jackson Airport, Jacksonville, Fla. The accident was described by expert and fire and air 17 companies, including the case of fire, was killed.

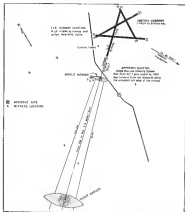
Flight 642, registered at Miami, Fla. with its destination Boston, Mass. Jacksonville, Fla., was scheduled to arrive approximately 10:00 p.m. The captain was seated in the cockpit, and the co-pilot was seated in the left seat. The aircraft was cleared to land. Shortly thereafter, the tower controller observed a large flash on the runway of the ILS middle marker. Calls to Flight 642 were not acknowledged and an emergency was declared for the accident. It was subsequently learned that N 112A had crashed approximately on the edge of a mile north

100 elements were on-hand with the Constellation, Model L-7494, N 112A, owned by Eastern Air Lines Inc., and operated by Flight 642, crashed during its ILS (Instrument Landing System) approach to runway 5, Jackson Airport, Jacksonville, Fla. The accident was described by expert and fire and air 17 companies, including the case of fire, was killed.

After acknowledging the accident, the tower controller, Jacksonville, Fla., reported that the aircraft was on the runway, and was cleared to land. Shortly thereafter, the tower controller observed a large flash on the runway of the ILS middle marker. Calls to Flight 642 were not acknowledged and an emergency was declared for the accident. It was subsequently learned that N 112A had crashed approximately on the edge of a mile north

east of the threshold of runway 5. Investigation disclosed the main portion of the wreckage to be 212 feet northwest of the ILS middle marker and 5400 feet southwest of the threshold of runway 5. The time of the accident was established as 10:14.

First impact of the accident was the top of a small pine tree approximately 200 feet below the ILS glide path, 350 feet to the left of the extended centerline of the runway, 4500 feet from the threshold of runway 5, and 400 feet southwest of the middle marker. This was followed by striking a 14-foot oak tree the upper 15 feet of which was sheared off. The aircraft rolled toward the ground, striking other logs, trees which destroyed both wings and a portion of the fuselage. Ground contact was into a heading of approximately 37 degrees magnetic. The distance



NOTE: When Eastern Air Lines Constellation crashed near Jacksonville, Fla., it crashed by one in a mile. Accidents prove, including the accident, were killed.

SAFETY

operating difficulties. The fight had been given all necessary elements and weather information.

The testimony of witnesses who observed the landing lights of the second plane, as drawing the approach and other witnesses who saw no landing lights, is not completely incompatible. Since the lights were fixed in the aircraft position it is only stated that once, located they might have been attracted to elements reflection in the mirror dissipated into the layer of fog. Also, some witnesses heard a single of gunshot before impact with the tower, which indicates that the pilot was attempting a rollout.

Every possible effort was made to prevent the jet-propelled aircraft being in the area when the accident occurred. 4.8 miles

taxi drivers were contacted and each and then had no jet aircraft flying in that area at the time of the accident. Neither the tower personnel, enroute on the airport nor witnesses other than the truck driver saw the accident occur. No jet aircraft and no jet aircraft were not observed on the radar scope.

In view of the track-dryers testimony, the Florida Air National Guard makes the diameter of a C-119 investigation, while several flights (using a jet aircraft) as an effort to establish the conditions described by the track-dryer. Each of these flights was plainly visible on the radar scope. It therefore is concluded that no such aircraft were in the vicinity.

The turn listed on HR. Right plus power
to leave Nixon and give to the situation

Ocala, Fla. The flight to Jacksonville was made in clear weather and clouds or obscuration were not encountered until in the vicinity of Jacksonville.

From a testimony of other pilots flying on the same day a short time prior to the accident, Bess was a layer of cloud, which included smoke and fog-ropping the airport with a general foggy condition existing at the miles to the southeast. All other areas appeared to be clear. It therefore appears likely that Flight 940 was clear of clouds from the Newberry Intersection to the final mile marker and continued to the ocean marker and that it probably did not encounter obscurement until in the vicinity of the middle marker enroute.

Although this weather condition has been described in general agreement with horizontal visibility of overball side, it is apparent from the testimony of pilot that vertical visibility throughout the area was generally good. Some of the witnesses said the ground visibility at and near the accident was poor. There is no way of determining ceiling height or visibility distance at the accident site. However, the weather information reported to the crew was observed at the control tower.

The house is located approximately one mile north-northeast of the accident scene. At the time of the accident a wind is no longer blowing from the north-northeast and it is believed that between the time of the last reporting and the accident the weather conditions at the observation point could have moved to the point of view of the accident and therefore should have been essentially the same as that reported on the case. "Indefinite 304 sky observed within 4 mile and fog."

Viscosity Coefficient

Learning that workday conditions were similar at the catch point and the observation point, conservation should be given to the doctrine of horizontal mobility with elevation. Horizontal mobility may have been near zero at 190 feet above the ground. Normally, that mobility above the plate path should have gradually increased as the surface descended.

As previously mentioned, the side rope at Jacksonville does not reflect accurately. However, since the side against failure, that the amount was observed to be beyond the outer marker, make a procedure that and strain released it is believed that the was accomplished at the normal depth of 1,200 feet. The popliteal dash mark at the same indicated the speed of the current at impact to be 140 knots. The company's withdrawal for this type service is a recommended approach spend a 110 knots, but the outer marker to 60 minutes, without alternate.

Ductless indicators that the aircraft is flying at a normal manner put great impact and there is no known evidence to indicate any malfunctioning of the aircraft or any of its components. The flap were intended to a position used for maneuvering and the amount of flap extension is usually used as the type of a smooth could achieve the middle marker

Although the aircraft was 120 feet to the left of course, this is a small distance at that point in the approach and only slight correction would have been required to align along with the runway. The de-

But the airplane was on a slight right turn and almost level horizontally at impact would suggest that the pilot was turning toward the beach at impact, rather than, causing the wreck to be under control.

It is not unusual, with weather conditions such as existed this day, for pilots desiring to approach in an attempt to land airships and balloons that vary from those reported. These variations may be either on the low or high side. If, on the morning of the accident, Captain McInnes had the visibility to be lower than one-half mile, it would then have been his responsibility to execute a missed-approach procedure.

FINDINGS

On the basis of all available evidence the Board finds that

- 1 The aircraft, the crew, and the crew with a few exceptions were generally content.
- 2 The aircraft's gross weight at takeoff was under the maximum allowable gross flight weight, and the load was properly distributed.
- 3 The flight was routine to Jacksonville and the state of the final approach.
- 4 No evidence of failure of the airframe, powerplant, controls, or other components was observed.
- 5 The weather at the airport was not good with local fog and restricted visibility. However, at last report the weather was above the minimum.
- 6 Ground navigational facilities on the Jacksonville area, including the ILS system, functioned normally during the approach.
- 7 There was no operating difficulty reported by the crew.
- 8 There were no other known aircraft in the immediate area.

PROBABLE CAUSE

By the Civil Aeronautics Board

Devor, Chairman, did not participate in the adoption of this report.

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident at approximately 0400 GCT on Dec. 23, 1955. An investigation was immediately begun in accordance with the provisions of Section 781 (a) (2) of the Civil Aeronautics Act of 1950, as amended. Six depositions were taken in Jacksonville, Fla., on Jan. 24, 1956, and a public hearing

was held in Coral Gables, Fla., on Jan. 26 and 27, 1956.

Barber Ar Line, Inc., is a Delaware Corporation and maintains its principal office at New York, N. Y. The company procures certificates of public convenience and necessity issued by the Civil Aeronautics Board and its sister operating certificates issued by the Civil Aeronautics Administration which authorize the carriage of persons, property, and mail over the route described in this report.

FLIGHT PERSONNEL

Captain Thomas Francis McEgan, age 41, was employed by Eastern Air Lines Oct. 26, 1942, and promoted to captain May 29, 1946. He held a currently valid

live almost exclusively with savings of where transport plot, eagle and water-on gas bed, DGC 5, Marine 4-4, Coastline and, and light structure. Captain Mr. Brown had, according to company records, 12,412 hours of pilot time, of which 2,800 hours was acquired in Coastline ser-

He passed a low check on 1-7-69 as well as April 4, 1975, and an environment check on 1-10-69 as well as July 21, 1975. His last detailed physical examination was passed August 31, 1975. Last period piece to the subject flight was 95 hours.

Pilot John Jay Rivers, age 37, was employed by Eastern Air Lines April 16, 1951. He held an ocean certificate with ratings of commercial pilot, single and multi-engine land, and instrument. Pilot Rivers



IBM Can't Afford Downtime!

With a limited number of airplanes and a large number of flights—IBM just can't afford unscheduled downtime. Airwork engines give the performance this company demands . . . and back them with outstanding personal service.

NOW NATIONWIDE SERVICE

If you should ever have a warranty problem with any Aircoast overhauled Pratt & Whitney Aircraft engine or its accessories while away from home base, contact the nearest P&WA Authorized Distributor who will take care of you for us.

YOU'RE SAFER WITH AIRWORK OVERHAULED ENGINES



ATLANTA,
MISSISSIPPI

Journal of Interpersonal Violence

Airwork
CORPORATION
Millville, New Jersey



NOW A BETTER, SAFER WAY TO SHIP SPARE PARTS in custom-engineered cabinets by CRAIG

A well-known electronics manufacturer recently came to CRAIG with a severe "spare parts" headache. His problem: to make complete, transportable hundreds of spare parts for field equipment—and at the same time provide quick and easy access to each individual part in order to avoid delays in making repairs.

CRAIG's answer: lightweight, rugged, waterproof aluminum cabinets with sturdy, removable drawers, indexed and compartmented to make each component easy to find—including provisions for such "spare" as computer receivers and transmitters shockproofed as special shielded frames.

Result: spare parts now travel fast clean in complete safety—and at surprisingly low cost, because CRAIG has the men and the means to do a job job economically... and fast.

For more detailed information and descriptive specifications, write CRAIG today.

Craig
SYSTEMS, INC.

Dept. C 101 Dorton Blvd.
Phone: Denver 1970



COMPLETE SYSTEMS CASE STUDY
AVAILABLE — Contact by
CRAIG, located at the
TACOM post office, will
show you just how the
company system was
used. This resolution is
available with each unit
drawn.

SAFETY

had, according to company records, 9,922 hours of pilot time of which 5,350 were assigned to Coast-Britain service. The first solo check was Oct. 17, 1955, and he was qualified on L-749 exactly Dec. 1, 1955. The first CVA formation flight assignment was given April 5, 1956, classified as very good command. According to Capt. Air Regularity. A company aircraft was given on Aug. 25, 1955. Also given prior to the subject flight was 15 hours.

Flight Engineer Charles Calen Davis, age 30, was employed by Eastern Air Lines May 9, 1955. He held a currently effective senior certificate with rating of flight engineer. Mr. Davis had, according to company records, a total of 157 hours flying time all of which had been acquired in Coast-Britain. He also had 9,500 hours as a flight member on the L-749 Air Force. His last CVA flight assignment was taken Aug. 21, 1955. The date of his last solo check was Oct. 5, 1955. Last period prior to the subject flight was 17 hours.

Flight Attendant Emma Elizabeth Willington, age 31, was employed by Eastern Air Lines February 15, 1955 as a student flight attendant and was promoted to flight attendant March 5, 1955.

Flight Attendant Clara Dorothy Romano, age 25, was employed by Eastern Air Lines October 28, 1954, as a student flight attendant and was promoted to flight attendant November 5, 1954.

THE AIRCRAFT

N 112A, a Lockheed model 1,190A, Constellation model 2175, was owned by Eastern Air Lines Inc. Its serial number was completed as a model 549 1432 serial on August 1, 1957 and registered to N 112A, September 2, 1958, in accordance with CAA specifications No. M77. Total flight time on the airplane was 25,941 hours. The aircraft was a four-engine, powered with Hamilton Standard model 4460 propellers. The main fuselage on the engine model had been 553 and 1,577 hours operation time between engine overhaul at 1,125 hours. These times overlaid on the inspection record the time on the engine (approved time between overhauls on propellers a 1,512 hours).

Air Terminal Sought Across Victoria Lines

London—A \$14-million plan to build a 5-acre international air terminal and office headquarters across Victoria Lines at Victoria Station, London, has been submitted to the Southern Region of British Railways.

The preliminary plan will make provision for a 2,000-car multi-floor garage with mechanical parking equipment. Room is left for a helicopter landing platform which can be incorporated in the stage when the decision is made a central helicopter station in London has been made.

Complete Missile Organization needs men with PhD MS BS

Highly talented persons create every aspect of our missile defense, from the design of the missile itself to the development of the missile itself. We need men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE FACTORY: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE TEST CENTER: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE DESIGN: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE PRODUCTION: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE MAINTENANCE: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE REPAIR: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE INSPECTION: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE TESTING: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE EVALUATION: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

MISSILE DEVELOPMENT: We are looking for men with PhD MS BS to do this. Send resume to: Director, Defense Research Agency, Washington, D.C. 20330.

EMPLOYMENT OPPORTUNITIES

EMERSON

NATIONAL COVERAGE

An opportunity to work in a dynamic environment. Send resume to: Emerson Electric Co., Dept. 100, St. Louis, Mo. 63101.

EMERSON

An opportunity to work in a dynamic environment. Send resume to: Emerson Electric Co., Dept. 100, St. Louis, Mo. 63101.

EMERSON

An opportunity to work in a dynamic environment. Send resume to: Emerson Electric Co., Dept. 100, St. Louis, Mo. 63101.

ENGINEERS

- Me's
- Gas Dynamics
- Controls

Keep abreast of a SINGLE STAGE compressor pump a pressure ratio of over 5 to 1 with an efficiency better than any modern multi-stage axial.

This and more has been accomplished by engineers at Republic Aviation Corporation, working in the advanced field of SUPERSONIC INDUCTION SYSTEMS design.

Most difficult and challenging problems exist in designing and controlling these variable geometry units.

Creative-minded engineers on all levels of experience can contribute to these new and highly important components of super-sound aircraft.

Would be glad to discuss with you the prospects of a satisfying, meaningful future at Republic? This—our many employees benefit (including our non-union 401(k) retirement plan), Long Island City, New York—(the most advanced way of life in America) is yours and tomorrow, is yours.

Please send resume, including details of your technical background, to:

Mr. David G. Reid
Engineering Personnel Manager



REPUBLIC AVIATION

FARMINGDALE, LONG ISLAND, NEW YORK

ENGINEERS...PHYSICISTS

NEW opportunities at
Motorola in Chicago

give yourself and your family
all the big city advantages at a
relaxed midwest pace, while you
ADVANCE YOUR CAREER

Outstanding career opportunities are waiting at the many Motorola research and development laboratories in the Chicago area. This is your opportunity to advance your career with a swiftly expanding company, working in the most modern and well instrumented laboratories—with liberal employee benefits, including an attractive profit sharing plan and association with men of the highest technical competence.

You'll be living in one of the beautiful suburbs of the playground of the midwest, where there are endless social, cultural, and educational activities to choose from the year-round. Exciting life or quiet life—Chicago offers either.

POSITIONS AVAILABLE include new communications • reliable electronics • radio & TV (radio) • weapons systems • computer application & design • translator research & production • microwave systems • servo-mechanisms • physical chemistry • metallurgical eng • field eng • electronic aids eng • drafting, design, & layout • acoustics • radar & military electronics

Write Mr. L. E. Wynn, Dept. 50, 4501 Augusta Blvd., Chicago 31, IL

ALSO . . . there are excellent opportunities in PHOENIX, ARIZ. and RIVERSIDE, CALIF.

PHOENIX, ARIZ. Outdoor, relaxed living the year-around, with lots of room to grow (on the job and off) in the land of sunshine.

RESEARCH
LABORATORY

Write to:
Mr. E. Culler
Dept. 5
1101 N. 5th St.
Phoenix, AZC

RESEARCH
LABORATORY

Write to:
Mr. V. Sorenson
Dept. 5
2601 N. McDowell Rd.,
Phoenix, Ariz.

RIVERSIDE,
CALIF.

Planned expansion into modern shops and modern aids research facilities. Big bang in science. There's room to grow and move fast in Riverside.

Write to:
Mr. C. Kuzal
Dept. 5
Box 2007
Riverside, Calif.


MOTOROLA
The Future Comes
SOONER at RMI

Advanced technology and scientific research are the backbone of RMI. Your new future, with new ideas, is a matter of time and energy.

APPLICATIONS ENGINEER

A new field in applications with scientific and technical background in engineering or science. You will be responsible for the design and development of new products and systems.

You will develop, coordinate, and manage the design and development of new products and systems. You will be responsible for the design and development of new products and systems.

TECHNICAL PLANNING ENGINEER

Advanced design. You will be responsible for the design and development of new products and systems. You will be responsible for the design and development of new products and systems.

U.S. CITIZENSHIP REQUIRED

U.S. citizens or permanent residents only. You will be responsible for the design and development of new products and systems.

Send resume to: Mr. J. H. Smith, RMI, 1000 N. 1st St., Phoenix, AZC.

REACTION MOTORS, INC.

60 Ford Road, Davilla, N. C.

Write to: Mr. J. H. Smith, RMI, 1000 N. 1st St., Phoenix, AZC.



The proof of the pudding

Not long ago this long-awaited, lightweight scope capsule for jet aircraft was merely an idea in the mind of an enthusiastic engineer. Today it is a long-awaited reality which will give our pilots added assurance and safety on their important missions in our nation's defenses. What turned this "hunch" idea into a realistic accomplishment? The answer is creative engineering—our specialty at Goodyear Aircraft—where transforming ideas into working realities has become a habit.

Here ideas are a prime commodity. Inventive and ingenuity are our raw materials. And to help put their ideas to work, our engineers have the most modern facilities available, including use of the world's largest computer laboratories. Here, every idea has a chance.

And many of them make the grade, as the record will show. Both in peace and in war, our engineers have turned their ideas into significant accomplishments that benefit nearly every aircraft in our skies. Now, let's

review, electronic guidance and computing equipment, structural materials, plastics—the list is long and broad. And it's still growing.

This continued growth and diversification demand that our engineering staff be expanded both at Akron, Ohio, and Linfield Park, Illinois. Opportunities are available for creative engineers in all specialties. So, if you have faith in your ideas and confidence in your ability to make them work, there's a challenging career waiting for you at Goodyear Aircraft.

Selusions and benefits are, of course, liberal. And if you wish to continue your academic studies, company-paid tuition covers leading to advanced degrees are available at nearby colleges.

For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jones, Personnel Department, Goodyear Aircraft Corporation, Akron 15, Ohio.

They're doing big things at

GOODYEAR AIRCRAFT

THE TEAM TO TEAM WITH IN AERONAUTICS

EXPERIENCE TIPS THE SCALES



ARQ, INC. "heavyweights" in engineering and management are men with a wide range of experience.

ARQ, INC. offers positions which will give an unrivalled knowledge of the engineering field.

ARQ, INC. manages, operates and maintains the wind tunnels and engine test cells of the Air Force's Arnold Engineering Development Center.

ARQ, INC. engineers work and associate with major propulsion and engine manufacturers and their latest projects.

ARQ, INC. has attractive incentives: longer vacations, liberal hospitalization, retirement and insurance benefits and a new, fully accredited, company-sponsored, graduate degree program.

Write: Lee C. Kelley, Box 162

ARQ, INC.
TULLAHOOP, TENNESSEE
A subsidiary of American Bracing Inc., St. Louis, Missouri
ARNOLD ENGINEERING DEVELOPMENT CENTER

VICKERS INCORPORATED

OFFERS

THE FOLLOWING OPPORTUNITIES

AIRCRAFT SALES ENGINEER—SR. POWER PLANT SPECIALIST

Engineering degree with knowledge of gas turbine engine—engineering or related accessories.

AIRCRAFT SALES ENGINEER—SR. MISSILE SPECIALIST

Engineering degree and experience with missiles or missile systems in the engineering or sales end.

AIRCRAFT SALES COORDINATOR INSIDE COORDINATOR ENGINEER

Engineering degree and experience with aircraft, aircraft engines, missile or general sales.

Phone 2, E. Berlew
Liberty 9-1132

or address reply to

VICKERS INCORPORATED

Maintenance and Engineering Center
Box 902 Detroit 26, Michigan

SYSTEMS and PROCEDURES ENGINEER ADMINISTRATIVE

A leading mid-west aircraft manufacturer has an excellent supervisory position for a qualified man to head up a Subcontractor Systems and Procedures Department for a large engineering division. This position will require consultation with manufacturing and other company divisions. Applicant must have a good working knowledge of engineering regulations, college degree, 3-5 years experience. Excellent salary and comprehensive fringe benefits. Send brief resume to:

PERSONNEL
115 N. Michigan Ave., Chicago 10, Ill.



new slant on SKYWRITING

New methods of instrumentation and data processing have changed the face of flight test. Today,

it's a bonanza of electronic advances which streamlines the data test history through telemetry.

And nowhere is advancement more apparent than in the field now called that of Chance Vought where flight test and instrumentation engineers find outstanding incentives and equipment.

- A department of their own, for example, where flight test specialists may advance to top technical or administrative positions.
- Modern ground station equipment, including specialized and mobile subspace data linkages, instrumentation facilities which incorporate analog equipment and PPM/FM and PM/FM telemetry systems.
- Freedom to conduct electronic research and to build up, install and field test their own designs.
- A complete instrumentation laboratory to facilitate exploratory work in instrumentation.

You'll want to know more about our emphasis on experimental flight test, particularly if you are an electrical or mechanical engineer. You can get full details—and an evaluation of your qualifications—by addressing a resume of your education and experience to:

Engineers Personnel Dept. 10-3
CHANCE VUGHT AIRCRAFT
INCORPORATED DALLAS TEXAS



HOT TIP

(For Electronics)

The big countdown has begun! In a matter of months, the tip of a Martin rocket will travel through space at a speed of 8 miles per second—and moments later the first man-made satellite will reach its orbit.

This event, the first of a series of 12 in the Martin-Navy VANGUARD program, will commence a new chapter in the short but exciting story of electronics.

Today, no other engineering organization in the world is more concerned with the outer-space electronics problems of tomorrow.

If you are interested, contact J. M. Hollyday, Dept. AW-10, The Martin Company, Baltimore, Maryland.

MARTIN
BALTIMORE

APPLICATION ENGINEERS

A long established manufacturing concern, due to an expansion program, has immediate need for qualified application engineers. Industrial Sales experience of wireless electrical equipments and an engineering degree or equivalent required. Positions open in California and Metropolitan New York areas.

Write letter of application giving full particulars to our Employment Department.

SCINTILLA DIVISION
Rendix Aviation Corporation
Sunnyvale, New York

Engineer, ME AE EE

NUCLEAR AIRCRAFT ENGINE TEST

There is an exciting challenge about new types of aircraft engines in nuclear power. We need men who know the theory and practice of aircraft engines.

All General Electric's AEP Engineers must have a master's degree in the field of nuclear engineering or a master's degree in a related field.

The position is available in one of our many departments. You will be working on the design and development of nuclear aircraft engines. You will be working on the design and development of nuclear aircraft engines.

For more information, write to the person in charge of the position.

OPENINGS IN CHICAGO, OHIO AND HOUSTON, TEXAS

Write letter to address, stating salary requirements, to the person in charge.

J. E. Smith
P. O. Box 100
Chicopee, MA

J. E. Smith
P. O. Box 100
Chicopee, MA

GENERAL ELECTRIC

ENGINEERS

AC OFFERS YOU SECURITY

G M's long-standing policy of decentralization creates unlimited opportunities for qualified Electrical, Mechanical Engineers and Engineering Technicians.



DEVOTED TO RESEARCH

AVIONICS - MISSILE GUIDANCE
- JET ENGINE FUEL CONTROLS - COMPUTERS
- COMMUNICATION EQUIPMENT - CIVIL DEFENSE
AVIATION - AUTOMOTIVE ELECTRONIC PRODUCTS
all offer you personally opportunities that demand investigation. To arrange personal, confidential

interview in your territory, write today to
Mr. John F. Hoffinger,
Supervisor of Salaried Personnel.

AC THE ELECTRONICS DIVISION
General Motors Corporation

Warren, Michigan

Flint, Michigan

For a confidential opinion as to how YOU can fit AC in your "Challenging Program" write to us today.



**WORLD'S FOREMOST
LODESTAR
SERVICE CENTER**

Inspection
Maintenance
Instrumentation
and Engine
Overhaul

Radio
Instruments
Engine Change
Overhaul
Radio

LEAR
AIRCRAFT CONTROLS DIVISION
Enter Aircraft Repair, Service and Repairs,
Nashville, Tennessee

**7 TO 10 DAY
INSTALLATION
RADAR**

Advanced
EC-4

Advanced
EC-4

CONTRACT RADARS FOR A-10 AIRCRAFT

With 10 years of experience in the installation and maintenance of radar systems, we are now offering a complete line of radar systems for the A-10 aircraft. Our systems are designed to meet the needs of the A-10 aircraft and are available in a variety of configurations. We have a large inventory of radar systems and can deliver them within 7 to 10 days. Our systems are reliable and easy to maintain. We have a large inventory of radar systems and can deliver them within 7 to 10 days. Our systems are reliable and easy to maintain.

Remmert-Werner

Inc. of St. Louis, Florida, Texas
Lester Field, Florida, Texas
Lester Field, Florida, Texas

Lester Field, Florida, Texas

Remmert-Werner, Lester Field, Florida, Texas

**WANTED
SUPER TWIN BEESCHRAFT
1100 or 1100 Model**

Just New Low Cost - Great Lowest Cost

W-1100, 1100 Model

Check with 1100, 1100 Model, 1100, 1100 Model

RAS

"Take a Heading for Reading"

Be the BEST MAINTENANCE • OVERHAUL • MODIFICATION • INSTALLATION

BRADING AVIATION SERVICE, INC.

Midwest Airport, Reading, Pennsylvania

Page

RADAR • DME

**AUTOMATIC PILOTS
NAVIGATION AND
COMMUNICATION SYSTEMS**

PHOENIX, FLA. N.F.

**FLY FRIENDSHIP
AIRPORT**

TO WASHINGTON - BALTIMORE

At work in Washington - Baltimore - Baltimore

Complete facility for air working

**DOUGLAS
DC-3**

For sale, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 2681, 2682, 2683, 2684, 2685, 2686, 2687, 2688, 2689, 2690, 2691, 2692, 2693, 2694, 2695, 2696, 2697, 2698, 2699, 2700, 2701, 2702, 2703, 2704, 2705, 2706, 2707, 2708, 2709, 2710, 2711, 2712, 2713, 2714, 2715, 2716, 2717, 2718, 2719, 2720, 2721, 2722, 2723, 2724, 2725, 2726, 2727, 2728, 2729, 2730, 2731, 2732, 2733, 2734, 2735, 2736, 2737, 2738, 2739, 2740, 2741, 2742, 2743, 2744, 2745, 2746, 2747, 2748, 2749, 2750, 2751, 2752, 2753, 2754, 2755, 2756, 2757, 2758, 2759, 2760, 2761, 2762, 2763, 2764, 2765, 2766, 2767, 2768, 2769, 2770, 2771, 2772, 2773, 2774, 2775, 2776, 2777, 2778, 2779, 2780, 2781, 2782, 2783, 2784, 2785, 2786, 2787, 2788, 2789, 2790, 2791, 2792, 2793, 2794, 2795, 2796, 2797, 2798, 2799, 2800, 2801, 2802, 2803, 2804, 2805, 2806, 2807, 2808, 2809, 2810, 2811, 2812, 2813, 2814, 2815, 2816, 2817, 2818, 2819, 2820, 2821, 2822, 2823, 2824, 2825, 2826, 2827, 2828, 2829, 2830, 2831, 2832, 2833, 2834, 2835, 2836, 2837, 2838, 2839, 2840, 2841, 2842, 2843, 2844, 2845, 2846, 2847, 2848, 2849, 2850, 2851, 2852, 2853, 2854, 2855, 2856, 2857, 2858, 2859, 2860, 2861, 2862, 2863, 2864, 2865, 2866, 2867, 2868, 2869, 2870, 2871, 2872, 2873, 2874, 2875, 2876, 2877, 2878, 2879, 2880, 2881, 2882, 2883, 2884, 2885, 2886, 2887, 2888, 2889, 2890, 2891, 2892, 2893, 2894, 2895, 2896, 2897, 2898, 2899, 2900, 2901, 2902, 2903, 2904, 2905, 2906, 2907, 2908, 2909, 2910, 2911, 2912, 2913, 2914, 2915, 2916, 2917, 2918, 2919, 2920, 2921, 2922, 2923, 2924, 2925, 2926, 2927, 2928, 2929, 2930, 2931, 2932, 2933, 2934, 2935, 2936, 2937, 2938, 2939, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 2948, 2949, 2950, 2951, 2952, 2953, 2954, 2955, 2956, 2957, 2958, 2959, 2960, 2961, 2962, 2963, 2964, 2965, 2966, 2967, 2968, 2969, 2970, 2971, 2972, 2973, 2974, 2975, 2976, 2977, 2978, 2979, 2980, 2981, 2982, 2983, 2984, 2985, 2986, 2987, 2988, 2989, 2990, 2991, 2992, 2993, 2994, 2995, 2996, 2997, 2998, 2999, 3000, 3001, 3002, 3003, 3004, 3005, 3006, 3007, 3008, 3009, 3010, 3011, 3012, 3013, 3014, 3015, 3016, 3017, 3018, 3019, 3020, 3021, 3022, 3023, 3024, 3025, 3026, 3027, 3028, 3029, 3030, 3031, 3032, 3033, 3034, 3035, 3036, 3037, 3038, 3039, 3040, 3041, 3042, 3043, 3044, 3045, 3046, 3047, 3048, 3049, 3050, 3051, 3052, 3053, 3054, 3055, 3056, 3057, 3058, 3059, 3060, 3061, 3062, 3063, 3064, 3065, 3066, 3067, 3068, 3069, 3070, 3071, 3072, 3073, 3074, 3075, 3076, 3077, 3078, 3079, 3080, 3081, 3082, 3083, 3084, 3085, 3086, 3087, 3088, 3089, 3090, 3091, 3092, 3093, 3094, 3095, 3096, 3097, 3098, 3099, 3100, 3101, 3102, 3103, 3104, 3105, 3106, 3107, 3108, 3109, 3110, 3111, 3112, 3113, 3114, 3115, 3116, 3117, 3118, 3119, 3120, 3121, 3122, 3123, 3124, 3125, 3126, 3127, 3128, 3129, 3130, 3131, 3132, 3133, 3134, 3135, 3136, 3137, 3138, 3139, 3140, 3141, 3142, 3143, 3144, 3145, 3146, 3147, 3148, 3149, 3150, 3151, 3152, 3153, 3154, 3155, 3156, 3157, 3158, 3159, 3160, 3161, 3162, 3163, 3164, 3165, 3166, 3167, 3168, 3169, 3170, 3171, 3172, 3173, 3174, 3175, 3176, 3177, 3178, 3179, 3180, 3181, 3182, 3183, 3184, 3185, 3186, 3187, 3188, 3189, 3190, 3191, 3192, 3193, 3194, 3195, 3196, 3197, 3198, 3199, 3200, 3201, 3202, 3203, 3204, 3205, 3206, 3207, 3208, 3209, 3210, 3211, 3212, 3213, 3214, 3215, 3216, 3217, 3218, 3219, 3220, 3221, 3222, 3223, 3224, 3225, 3226, 3227, 3228, 3229, 3230, 3231, 3232, 3233, 3234, 3235, 3236, 3237, 3238, 3239, 3240, 3241, 3242, 3243, 3244, 3245, 3246, 3247, 3248, 3249, 3250, 3251, 3252, 3253, 3254, 3255, 3256, 3257, 3258, 3259, 3260, 3261, 3262, 3263, 3264, 3265, 3266, 3267, 3268, 3269, 3270, 3271, 3272, 3273, 3274, 3275, 3276, 3277, 3278, 3279, 3280, 3281, 3282, 3283, 3284, 3285, 3286, 3287, 3288, 3289, 3290, 3291, 3292, 3293, 3294, 3295, 3296, 3297, 3298, 3299, 3300, 3301, 3302, 3303, 3304, 3305, 3306, 3307, 3308, 3309, 3310, 3311, 3312, 3313, 3314, 3315, 3316, 3317, 3318, 3319, 3320, 3321, 3322, 3323, 3324, 3325, 3326, 3327, 3328, 3329, 3330, 3331, 3332, 3333, 3334, 3335, 3336, 3337, 3338, 3339, 3340, 3341, 3342, 3343, 3344, 3345, 3346, 3347, 3348, 3349, 3350, 3351, 3352, 3353, 3354, 3355, 3356, 3357, 3358, 3359, 3360, 3361, 3362, 3363, 3364, 3365, 3366, 3367, 3368, 3369, 3370, 3371, 3372, 3373, 3374, 3375, 3376, 3377, 3378, 3379, 3380, 3381, 3382, 3383, 3384, 3385, 3386, 3387, 3388, 3389, 3390, 3391, 3392, 3393, 3394, 3395, 3396, 3397, 3398, 3399, 3400, 3401, 3402, 3403, 3404, 3405, 3406, 3407, 3408, 3409, 3410, 3411, 3412, 3413, 3414, 3415, 3416, 3417, 3418, 3419, 3420, 3421, 3422, 3423, 3424, 3425, 3426, 3427, 3428, 3429, 3430, 3431, 3432, 3433, 3434, 3435, 3436, 3437, 3438, 3439, 3440, 3441, 3442, 3443, 3444, 3445, 3446, 3447, 3448, 3449, 3450, 3451, 3452, 3453, 3454, 3455, 3456, 3457, 3458, 3459, 3460, 3461, 3462, 3463, 3464, 3465, 3466, 3467, 3468, 3469, 3470, 3471, 3472, 3473, 3474, 3475, 3476, 3477, 3478, 3479, 3480, 3481, 3482, 3483, 3484, 3485, 3486, 3487, 3488, 3489, 3490, 3491, 3492, 3493, 3494, 3495, 3496, 3497, 3498, 3499, 3500, 3501, 3502, 3503, 3504, 3505, 3506, 3507, 3508, 3509, 3510, 3511, 3512, 3513, 3514, 3515, 3516, 3517, 3518, 3519, 3520, 3521, 3522, 3523, 3524, 3525, 3526, 3527, 3528, 3529, 3530, 3531, 3532, 3533, 3534, 3535, 3536, 3537, 3538, 3539, 3540, 3541, 3542, 3543, 3544, 3545, 3546, 3547, 3548, 3549, 3550, 3551, 3552, 3553, 3554, 3555, 3556, 3557, 3558, 3559, 3560, 3561, 3562, 3563, 3564, 3565, 3566, 3567, 3568, 3569, 3570, 3571, 3572, 3573, 3574, 3575, 3576, 3577, 3578, 3579, 3580, 3581, 3582, 3583, 3584, 3585, 3586, 3587, 3588, 3589, 3590, 3591, 3592, 3593, 3594, 3595, 3596, 3597, 3598, 3599, 3600, 3601, 3602, 3603, 3604, 3605, 3606, 3607, 3608, 3609, 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3618, 3619, 3620, 3621, 3622, 3623, 3624, 3625, 3626, 3627, 3628, 3629, 3630, 3631, 3632, 3633, 3634, 3635, 3636, 3637, 3638, 3639, 3640, 3641, 3642, 3643, 3644, 3645, 3646, 3647, 3648, 3649, 3650, 3651, 3652, 3653, 3654, 3655, 3656, 3657, 3658, 3659, 3660, 3661, 3662, 3663, 3664, 3665, 3666, 3667, 3668, 3669, 3670, 3671, 3672, 3673, 3674, 3675, 3676, 3677, 3678, 3679, 3680, 3681, 3682, 3683, 3684, 3685, 3686, 3687, 3688, 3689, 3690, 3691, 3692, 3693, 3694, 3695, 3696, 3697, 3698, 3699, 3700, 3701, 3702, 3703, 3704, 3705, 3706, 3707, 3708, 3709, 3710, 3711, 3712, 3713, 3714, 3715, 3716, 3717, 3718, 3719, 3720, 3721, 3722, 3723, 3724, 3725, 3726, 3727, 3728, 3729, 3730, 3731, 3732, 3733, 3734, 3735, 3736, 3737, 3738, 3739, 3740, 3741, 3742, 3743, 3744, 3745, 3746, 3747, 3748, 3749, 3750, 3751, 3752, 3753, 3754, 3755, 3756, 3757, 3758, 3759, 3760, 3761, 3762, 3763, 3764, 3765, 3766, 3767, 3768, 3769, 3770, 3771, 3772, 3773, 3774, 3775, 3776, 3777, 3778, 3779, 3780, 3781, 3782, 3783, 3784, 3785, 3786, 3787, 3788, 3789, 3790, 3791, 3792, 3793, 3794, 3795, 3796, 3797, 3798, 3799, 3800, 3801, 3802, 3803, 3804, 3805, 3806, 3807, 3808, 3809, 3810, 3811, 3812, 3813, 3814, 3815, 3816, 3817, 3818, 3819, 3820, 3821, 3822, 3823, 3824, 3825,



When Aviation Buyers Go to Market...

Be Sure Your Product or Service Is There

1957 Aviation Week Annual Buyers' Guide

AVIATION WEEK
A MCGRAW-HILL PUBLICATION

Aviation's Only Source for Complete Buying Information Offers Advertisers Exclusive Advantages

• SECTIONALIZED FORMAT FOR EFFICIENT USE BY BUYERS

Aircraft, Engines, Supporting Groups, Nuclear Power Systems, Airframe Assemblies and Aviation sections are set up to provide a quick and ready locator for all products, companies and their advertisements.

• BUYERS ARE DIRECTED TO ADVERTISEMENTS

Manufacturers' product listings are keyed to their advertisements through "an advertisement page" references.

• ADVERTISER'S PRODUCT-LISTING BOLD FACE

Companies advertising in the Buyers' Guide are listed in Bold Face in the appropriate section.

• READER SERVICE CARDS ARE KEYED TO ADVERTISEMENTS

It's as easy as 1-2-3 for buyers to request additional information about your product or services. Many thousands of reader inquiries have resulted from the 1956 Buyers' Guide, coming almost exclusively from engineering-management men, research scientists and top military men... the men who do Aviation's buying today.

• YEAR-ROUND SELLING POWER ASSURED

Work after work, since the 1956 Buyers' Guide was published last December, reader inquiries have been streaming in and are still coming ten months later, even as the 1957 Buyers' Guide prepares to go to press.

• AVIATION'S LARGEST ENGINEERING-MANAGEMENT AUDIENCE

The Annual Buyers' Guide is a special service issue which last year provided the industry with 582 pages of the latest detailed government information. Included were 37,580 cross-referenced company and product listings and 221 pages of advertisements describing manufacturers' products and services to aviation buyers across the United States and in 85 different countries. Aviation's largest audience of engineering-management men, research scientists and top military men—the men who do Aviation's buying today—will receive copies of the Buyers' Guide through AVIATION WEEK's circulation* (aviation's largest) and through additional circulation gained through out-of-pocket orders from industry, the military and foreign countries.

• SPECIAL DISCOUNTS ON MULTIPAGE AND CATALOG-TYPE SPACE

Your AVIATION WEEK representative will gladly help you plan your advertising to make more economical and resultant use of the Buyers' Guide. Contact Her or them. AVIATION WEEK BUYERS' GUIDE, 300 W. 42nd St., New York 36, N. Y.

Published December 1956

*Average net paid ABC circulation December June 1956 37,000
Paid circulation of current issue 40,000

Recent membership research by Advertising Research Foundation shows 1-4 readers for every subscriber copy of AVIATION WEEK's membership directory by general reference using strict registration test. Circulation paid order 100% 80,000.



All turn high above ceilings for today's aircraft are designed in the classroom.

Framed in this doorway... vital questions for engineers

How well it works in the air? At what altitude? For how long? To get the answers, nothing is spared to provide engineers with necessary and top-notch equipment at North American's Division.

Facilities include 16 completely equipped laboratories. In addition, a new state-of-the-art engineering building will soon be completed.

The Columbus Division has prime responsibilities for all North American's aircraft projects for the Navy—from coastal through flight. It is a vigorous, completely integrated organization whose advancement is based on individual responsibility. If you are an ambitious engineer who would like an instant

career opportunity, you owe it to your future growth to find out about openings in your field with us.

OPPORTUNITIES IN EVERY PHASE OF AIRCRAFT DEVELOPMENT

Aviation engineers, Test pilots, Engineers, Designers, Stress Engineers, Structural Test Engineers, Flight Test Engineers, Development and Research Engineers, Electrical and Electronic Engineers, Wind Tunnel Model Designers and Builders, Power Plant Engineers, Research and Development Engineers, Quality Engineers.

Get the full story "Write today" Mr. J. H. Pagan, Personnel Manager, Dept. 25, NAAW, North American's Columbus Division, Columbus 16, Ohio.

THE COLUMBUS DIVISION OF

NORTH AMERICAN AVIATION, INC.



ADVERTISERS IN THIS ISSUE

AVIATION WEEK—OCTOBER 29, 1966

4	A. O. SPARKS PLANT, THE ELECTRONIC DIV.	21	FLORIAN ROSE, INC.
5	ALCOHOL, METAL CO.	22	FLORIAN ROSE, INC.
6	ALCOHOL, METAL CO.	23	FLORIAN ROSE, INC.
7	ALCOHOL, METAL CO.	24	FLORIAN ROSE, INC.
8	ALCOHOL, METAL CO.	25	FLORIAN ROSE, INC.
9	ALCOHOL, METAL CO.	26	FLORIAN ROSE, INC.
10	ALCOHOL, METAL CO.	27	FLORIAN ROSE, INC.
11	ALCOHOL, METAL CO.	28	FLORIAN ROSE, INC.
12	ALCOHOL, METAL CO.	29	FLORIAN ROSE, INC.
13	ALCOHOL, METAL CO.	30	FLORIAN ROSE, INC.
14	ALCOHOL, METAL CO.	31	FLORIAN ROSE, INC.
15	ALCOHOL, METAL CO.	32	FLORIAN ROSE, INC.
16	ALCOHOL, METAL CO.	33	FLORIAN ROSE, INC.
17	ALCOHOL, METAL CO.	34	FLORIAN ROSE, INC.
18	ALCOHOL, METAL CO.	35	FLORIAN ROSE, INC.
19	ALCOHOL, METAL CO.	36	FLORIAN ROSE, INC.
20	ALCOHOL, METAL CO.	37	FLORIAN ROSE, INC.
21	ALCOHOL, METAL CO.	38	FLORIAN ROSE, INC.
22	ALCOHOL, METAL CO.	39	FLORIAN ROSE, INC.
23	ALCOHOL, METAL CO.	40	FLORIAN ROSE, INC.
24	ALCOHOL, METAL CO.	41	FLORIAN ROSE, INC.
25	ALCOHOL, METAL CO.	42	FLORIAN ROSE, INC.
26	ALCOHOL, METAL CO.	43	FLORIAN ROSE, INC.
27	ALCOHOL, METAL CO.	44	FLORIAN ROSE, INC.
28	ALCOHOL, METAL CO.	45	FLORIAN ROSE, INC.
29	ALCOHOL, METAL CO.	46	FLORIAN ROSE, INC.
30	ALCOHOL, METAL CO.	47	FLORIAN ROSE, INC.
31	ALCOHOL, METAL CO.	48	FLORIAN ROSE, INC.
32	ALCOHOL, METAL CO.	49	FLORIAN ROSE, INC.
33	ALCOHOL, METAL CO.	50	FLORIAN ROSE, INC.
34	ALCOHOL, METAL CO.	51	FLORIAN ROSE, INC.
35	ALCOHOL, METAL CO.	52	FLORIAN ROSE, INC.
36	ALCOHOL, METAL CO.	53	FLORIAN ROSE, INC.
37	ALCOHOL, METAL CO.	54	FLORIAN ROSE, INC.
38	ALCOHOL, METAL CO.	55	FLORIAN ROSE, INC.
39	ALCOHOL, METAL CO.	56	FLORIAN ROSE, INC.
40	ALCOHOL, METAL CO.	57	FLORIAN ROSE, INC.
41	ALCOHOL, METAL CO.	58	FLORIAN ROSE, INC.
42	ALCOHOL, METAL CO.	59	FLORIAN ROSE, INC.
43	ALCOHOL, METAL CO.	60	FLORIAN ROSE, INC.
44	ALCOHOL, METAL CO.	61	FLORIAN ROSE, INC.
45	ALCOHOL, METAL CO.	62	FLORIAN ROSE, INC.
46	ALCOHOL, METAL CO.	63	FLORIAN ROSE, INC.
47	ALCOHOL, METAL CO.	64	FLORIAN ROSE, INC.
48	ALCOHOL, METAL CO.	65	FLORIAN ROSE, INC.
49	ALCOHOL, METAL CO.	66	FLORIAN ROSE, INC.
50	ALCOHOL, METAL CO.	67	FLORIAN ROSE, INC.
51	ALCOHOL, METAL CO.	68	FLORIAN ROSE, INC.
52	ALCOHOL, METAL CO.	69	FLORIAN ROSE, INC.
53	ALCOHOL, METAL CO.	70	FLORIAN ROSE, INC.
54	ALCOHOL, METAL CO.	71	FLORIAN ROSE, INC.
55	ALCOHOL, METAL CO.	72	FLORIAN ROSE, INC.
56	ALCOHOL, METAL CO.	73	FLORIAN ROSE, INC.
57	ALCOHOL, METAL CO.	74	FLORIAN ROSE, INC.
58	ALCOHOL, METAL CO.	75	FLORIAN ROSE, INC.
59	ALCOHOL, METAL CO.	76	FLORIAN ROSE, INC.
60	ALCOHOL, METAL CO.	77	FLORIAN ROSE, INC.
61	ALCOHOL, METAL CO.	78	FLORIAN ROSE, INC.
62	ALCOHOL, METAL CO.	79	FLORIAN ROSE, INC.
63	ALCOHOL, METAL CO.	80	FLORIAN ROSE, INC.
64	ALCOHOL, METAL CO.	81	FLORIAN ROSE, INC.
65	ALCOHOL, METAL CO.	82	FLORIAN ROSE, INC.
66	ALCOHOL, METAL CO.	83	FLORIAN ROSE, INC.
67	ALCOHOL, METAL CO.	84	FLORIAN ROSE, INC.
68	ALCOHOL, METAL CO.	85	FLORIAN ROSE, INC.
69	ALCOHOL, METAL CO.	86	FLORIAN ROSE, INC.
70	ALCOHOL, METAL CO.	87	FLORIAN ROSE, INC.
71	ALCOHOL, METAL CO.	88	FLORIAN ROSE, INC.
72	ALCOHOL, METAL CO.	89	FLORIAN ROSE, INC.
73	ALCOHOL, METAL CO.	90	FLORIAN ROSE, INC.
74	ALCOHOL, METAL CO.	91	FLORIAN ROSE, INC.
75	ALCOHOL, METAL CO.	92	FLORIAN ROSE, INC.
76	ALCOHOL, METAL CO.	93	FLORIAN ROSE, INC.
77	ALCOHOL, METAL CO.	94	FLORIAN ROSE, INC.
78	ALCOHOL, METAL CO.	95	FLORIAN ROSE, INC.
79	ALCOHOL, METAL CO.	96	FLORIAN ROSE, INC.
80	ALCOHOL, METAL CO.	97	FLORIAN ROSE, INC.
81	ALCOHOL, METAL CO.	98	FLORIAN ROSE, INC.
82	ALCOHOL, METAL CO.	99	FLORIAN ROSE, INC.
83	ALCOHOL, METAL CO.	100	FLORIAN ROSE, INC.

'cheetes

**PERSONNEL
CARGO - FLARE
BOMB - MINE
DECELERATION**

*Ground
Simulation
Instruments*

Mills

Reinforcing Company
AERIALS - NORTH CAROLINA

Box 14 (2) Box 14 (2)
P. O. Box 14 P. O. Box 14

FAIRCHILD ENGINE DIVISION AND GAS TURBINE LABORATORY

If you are keenly interested in Research, Design or Development, and the modern gas turbine engine is either your field of experience or center of interest, contact...

*Felix Gordon
Fairchild Engine Division
Conner Road
Long Island, N. Y.
(All replies confidential)*



FAIRCHILD

ENGINE DIVISION - DEPT. 2000, P. O. BOX 1

A Division of Fairchild Engine and Airplane Corporation

— WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS —

VOODOO...AMERICAN STYLE



The supersonic McDonnell F101 "Voodoo" is typical of the high performance aircraft for which Servomechanisms, Inc. designs and produces Central Data Computers. These reliable subsystems measure physical factors, transduce this data to common form, produce corrected information, and compute desired input variables for all other systems in the aircraft.



The Wind Drift Computer, conceived by McDonnell engineers and developed jointly with Servomechanisms' is typical of our Mechatronics design philosophy, which assures maximum reliability as well as minimum down-time through pull-out, plug-in replacement of the individual packaged functions.

SERVOMECHANISMS
INC.

WESTERN DIVISION
Hawthorne, California

EASTERN DIVISION
Westbury, L. I., New York

MECHATROL DIVISION
Westbury, L. I., New York

MECHAPONENTS DIVISION
El Segundo, California